

FLORA DA RESERVA DUCKE, AMAZONAS, BRASIL: MELIACEAE

T. D. Pennington¹

Meliaceae, Ventenat, Tab. Règ. Vég. 3: 159-166. 1799.

Candolle, C. 1878. In Martius, Fl. bras. 11(1): 165.

Pennington, T. D. 1981. Fl. Neotrop. 28: 1-470.

Trees or treelets. Indumentum usually simple, less frequently stellate or of malpighiaceous hairs. Stipules absent. **Leaves** spirally arranged, usually pinnate, rarely trifoliolate or unifoliolate. Leaflets entire, venation usually eucamptodromous. **Inflorescence** usually axillary, usually paniculate with cymose branchlets (thyrsoid). **Flowers** bisexual or unisexual, plants monoecious, dioecious or polygamous. Calyx usually shallowly 3-5-lobed, or less frequently sepals free. Petals 4-7, free or partially united, aestivation imbricate or valvate. Filaments rarely completely free, usually partly or completely united to form an urceolate, cyathiform or cylindrical staminal tube, with or without appendages, anthers 5-10, hairy or glabrous, inserted apically on the filaments or on the margin of the staminal tube, or within the throat of the tube. Nectary (disk) intrastaminal or absent. Ovary 2-10-locular,

loculi 1-ovulate, 2-ovulate or multiovulate. Style-head capitate, conical or lobed. **Fruit** a loculicidal or septifragal capsule. **Seed** either winged, and then attached to a large woody columella, or unwinged and then with a fleshy or corky arillode or sarcotesta.

About 140 species in the Neotropics with a further 350-400 in Africa and Asia. They mostly occur in undisturbed lowland rain forest with only a few species in montane areas up to 2500 m altitude. The greatest species diversity is found from the Guianas, across Amazonia to western Brazilian Amazonia and Peru, with lesser centres in the Caribbean islands and coastal Brazil. This treatment includes the twenty-nine species which are found in the vicinity of Manaus, 19 of which occur in the Reserva Ducke.

The illustrations are adapted from Flora Neotopica 28 with permission from the New York Botanical Garden.

Key to the genera of Meliaceae in the Manaus area

1. Ovary loculi with 1-2 ovules, fruit a loculicidal capsule.
 2. Anthers inserted at apex of filaments or on margin of staminal tube 1. *Trichilia*
 2. Anthers inserted within the throat of the staminal tube 2. *Guarea*
1. Ovary loculi with 3-many ovules, fruit a septifragal capsule.
 3. Staminal tube of completely united filaments, anthers 8-10, inserted within the throat of staminal tube, seeds large, angular, woody, not winged 3. *Carapa*
 3. Stamens 5, filaments free, but adnate to an androgynophore below, anthers inserted apically on the filaments, seeds small, with a papery wing 4. *Cedrela*

1. *Trichilia*

Trichilia P. Browne, Hist. Jamaica 278. 1756.

Trees or treelets. Indumentum usually of simple hairs, less frequently of stellate, dibrachiate or malpighiaceous hairs. **Leaves** usually pinnate, less frequently trifoliolate or unifoliolate, leaflets sometimes glandular-

punctate and -striate. **Flowers** usually unisexual (plant dioecious), in axillary thyrsoid panicles. Calyx usually shallowly 4-6-lobed, or sepals free. Petals 4-5(-6), free or partially united, imbricate or valvate. Filaments completely united to form a staminal tube, usually with a toothed or lobed margin, or

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partly free and then with or without 2 terminal lobes or appendages; anthers 5–10, inserted on the margin of the staminal tube or apically on the filaments, hairy or glabrous. Nectary usually a fleshy annulus surrounding the base of the ovary, or absent. Ovary 2–3-locular, loculi with 1–2 collateral or superposed ovules; style-head usually capitate. **Fruit** a 2–3-valved loculicidal capsule, valves leathery

to woody, loculi 1–2-seeded. **Seed** fleshy, partly or completely surrounded by a thin or fleshy arillode, or rarely with a complete sarcotesta. Embryo with usually collateral or rarely superposed cotyledons.

About 80 species in tropical America, 14 in Africa and 2 in the Indo-Malayan region. Fifteen species occur in the environs of Manaus, including 10 in Reserva Ducke.

Key to the species of *Trichilia* of the Manaus area

1. Young shoots and inflorescence with minute stellate indumentum.
 2. Petiolule 4–5 mm long, leaflets often lanceolate, pericarp *ca.* 0.5 mm thick, seed surrounded by free arillode 2. *T. mazanensis*
 2. Petiolule 5–10 mm long, leaflets often broadly oblong, pericarp 1.5–2 mm thick, seed with a fleshy sarcotesta 1. *T. euneura*
1. Indumentum of simple or dibrachiate hairs.
 3. Petals imbricate, free.
 4. Staminal tube of completely united filaments 6. *T. septentrionalis*
 4. Staminal tube of partially united filaments.
 5. Twigs with numerous pale lenticels, inflorescence 6–15 cm long, with wide-spreading branches, petals 1.5–2.5 mm long, ovary glabrous 3. *T. micrantha*
 5. Twigs without numerous pale lenticels, inflorescence 1–4 cm long, little-branched, petals 3.5–6 mm long, ovary pubescent.
 6. Leaflets 7–9, sepals 5, petals 5, stamens 10, capsule 2.5–3 cm long, puberulous, drying greyish-brown 4. *T. rubra*
 6. Leaflets (3–)5, sepals 4, petals 4, stamens 8, capsule 1–2 cm long, densely pubescent, drying pale greenish-brown 5. *P. pallida*
 3. Petals valvate, usually partially fused.
 7. Leaflets dimorphic or heteromorphic, lowest pair much reduced and often a different shape, sometimes vestigial.
 8. Petals free.
 9. Reduced basal leaflets linear or linear subulate, leaves 1–5-foliolate, leaflet base not asymmetrical 13. *T. areolata*
 9. At least some of reduced basal leaflets with expanded blade, leaves 6–10-foliolate, leaflet base usually asymmetrical 14. *T. inaequilatera*
 8. Petals partially united (1/4 to 2/3 of their length).
 10. Leaflets 7–11, 14–25 cm long, secondary veins 20–30 pairs 11. *T. bullata*
 10. Leaflets 5–7, 3.2–15 cm long, secondary veins 9–12 pairs.
 11. Leaflets 3.2–7 cm long, petals *ca.* 2 mm long, anthers 7(–8) 10. *T. micropetala*
 11. Leaflets 9–15 cm long, petals *ca.* 3 mm long, anthers 9(–10) 12. *T. pleeana*
 7. Leaflets not dimorphic or heteromorphic.
 12. Leaves 1-foliolate 15. *T. singularis*
 12. Leaves 3–8-foliolate.
 13. Lower leaflet surface with sparse medifixed closely appressed hairs (lens), ovary 2-locular 15. *T. singularis*
 13. Lower leaflet surface without medifixed hairs, ovary 3-locular.

14. Leaflets 6–8, petals *ca.* 2 mm long 7. *T. cipo*
 14. Leaflets 4–5, petals 3.5–5 mm long.
 15. Petals fused for 2/3 to 3/4 of their length, remaining erect, anthers 5–7(–8), capsule 3.5–4.5 cm long 8. *T. aff. poeppigii*
 15. Petals fused *ca.* 1/5 of their length, reflexed, anthers 10, capsule 2–3.5 cm 9. *T. aff. schomburgkii*

1.1 *Trichilia euneura* C. DC., in A. & C. de Candolle, Monogr. Phan. 1: 673. 1878; Pennington & Styles, Fl. Neotrop. 28: 42, fig. 3. 1981. Fig. 1 a-c

Young shoots stellate-puberulous at first, soon glabrous, greyish-brown. **Leaves** pinnate, 12–15 cm long, petiole semiterete, rachis more or less terete, subglabrous. Leaflets 5–6, alternate, 10–15 × 4–6.8 cm, the lowest leaflets smaller than the upper, broadly oblong to elliptic, apex obtusely cuspidate to narrowly attenuate, base acute, obtuse or truncate, glabrous above, minutely and sparsely peltate-stellate or stellate puberulous below, glandular-punctate and -striate; venation eucamptodromous, midrib sunken on the upper surface, secondaries 9–12 pairs, straight and more or less parallel, intersecondaries absent, tertiaries oblique. Petiolule 5–10 mm long, channelled above. **Inflorescence** axillary, 3–6 cm long, a densely-flowered thyse, minutely stellate-puberulous. Pedicel *ca.* 1 mm long. **Flowers** unisexual (plant dioecious). Sepals 5, 1–2 mm long, free, imbricate, finely stellate-puberulous. Petals 5, 4–5 mm long, free, imbricate, stellate-puberulous outside, glabrous inside. Stamens 8, partially fused (1/3 to 1/2 their length) into an urceolate or cyathiform staminal tube 3–4 mm long, filaments terminated by 2 acute appendages about equalling the anthers, pubescent on both surfaces; anthers 0.5–1 mm long, sparsely hairy; antherodes of female flower slender, without pollen. Nectary minute or absent. Ovary ovoid, 3-locular, loculi with 2 collateral ovules, densely stellate-pubescent. **Capsule** 2.7–3.8 cm long, ellipsoid to obovoid, apex and base acute, smooth, densely stellate-puberulous, 3-valved, valves remaining erect. **Seed** solitary, 2.5–3.2 cm long, completely surrounded by a fleshy sarcotesta.

Field characters: Tree to 25 m high and 30 cm diameter, bole slightly fluted at the base, bark greyish, lenticellate, scaling in rather long slender pieces, slash without exudate. Flowers sweetly scented, with greenish-cream corolla and bright yellow anthers. Fruit and seed (sarcotesta) orange. Flowering in central Amazonia from July to September.

From Amapá and the Guianas across Amazonia to Peru, also in Venezuela, where it is confined to lowland rain forest on terra firme. *s.d.* (fl) Pennington, T. D. *et al.* 9933 (FHO INPA K). AMAZONAS: Presidente Figueiredo, Represa de Balbina on R. Uatumã, Thomas *et al.* 5260 (INPA K).

Trichilia euneura is closely related to *T. mazanensis* and shares the same geographical range. They are the only species in central Amazonia with an indumentum of stellate hairs. *Trichilia euneura* differs from *T. mazanensis* in its narrow elliptic or lanceolate leaflets, straight and more or less parallel secondary veins (arcuate and convergent in *T. mazanensis*), oblique tertiary veins (reticulate in *T. mazanensis*), and seed with fused sarcotesta (seed of *T. mazanensis* with free arillode). The species are also separated by their ecology, *T. euneura* occurring on non-flooded land while *T. mazanensis* is confined to flooded (várzea) and igapó forest and river margins.

1.2 *Trichilia mazanensis* Macbr., Publ. Field Mus. Nat. Hist., Bot. Ser. 13(3): 742. 1949; Pennington & Styles, Fl. Neotrop. 28: 45, fig. 3. 1981. Fig. 1 d-f

Young shoots finely stellate-puberulous at first, soon glabrous, lenticellate. **Leaves** pinnate, 9–15 cm long, petiole and rachis semiterete, subglabrous. Leaflets 7–9, alternate, 7–12 × 3–5 cm, elliptic to lanceolate, apex narrowly



Figure 1 - a-c. *Trichilia euneura* - a. habit; b. male flower (Pennington 9933); c. fruit and seed (Oldeman B2989). d-f. *T. mazanensis* - d. habit; e. male flower (Schunke 136); f. fruit and seed (Silva et al. 1706).

attenuate, base obtuse to narrowly attenuate, glabrous, glandular-punctate and rarely-striate; venation eucamptodromous, midrib flat on the upper surface, secondaries 8–9 pairs, steeply arcuate-ascending, convergent, intersecondaries short or absent, tertiaries reticulate, conspicuous on both surfaces, Petiolule 4–5 mm long, slightly channelled. **Inflorescence** axillary, 2–6 mm long, thyrsoid, stellate-puberulous. Pedicel 1–2 mm long. **Flowers** unisexual (plant dioecious). Sepals 5, 1–5 mm long, more or less free, slightly imbricate, stellate-puberulous. Petals 5, 4–5 mm long, free, imbricate, stellate-puberulous outside, glabrous inside. Stamens 9–10, partially fused (1/2 to 2/3 their length) into an areolate or cyathiform staminal tube 1.5–3.5 mm long, filament apex rounded or terminated by two short acute lobes about 1/3 of the length of the anther, hispid inside the tube, sparser indumentum outside; anthers 0.7–1 mm long, hairy; antherodes of female flower slender, without pollen. Nectary represented by small annular swelling around the base of the ovary. Ovary broadly ovoid, 3-locular, loculi with 2 collateral ovules, densely pubescent with a mixture of stellate and simple hairs. **Capsule** 2.5–3.5 cm long, ovoid, obovoid or ellipsoid, apex rounded, base rounded or tapered, smooth, densely puberulous with a mixture of simple and stellate hairs, 3-valved, valves remaining erect. **Seed** solitary, 2–3 cm long, surrounded by a free arillode which covers the seed except for a small area near the base.

Field characters: Tree to 20 m high with greenish-yellow flowers. The fruit matures greenish-yellow and the seed is surrounded by an orange arillode. Flowering in central Amazonia from December to March with the fruit maturing in July to August.

Trichilia mazanensis is confined to igapó and várzea forest, and its known distribution extends from Venezuela to southern Amazonian Brazil and Amazonian Peru.

Not recorded from Reserva Ducke.

AMAZONAS: Município de Manaus, junction of R. Negro and R. Solimões, *Ferreira* 289 (INPA K).

Trichilia mazanensis and *T. euneura* form an isolated pair of species within *Trichilia*. Their differences are discussed under the latter.

1.3 *Trichilia micrantha* Benth., in Hooker's J. Bot., Kew Gard. Misc. 3: 369. 1851; Pennington & Styles, Fl. Neotrop. 28: 69, fig. 8. 1981.

Fig. 2

Young shoots appressed puberulous, soon becoming glabrous, with numerous conspicuous pale lenticels. **Leaves** imparipinnate, 8–20 cm long, petiole semiterete, rhachis flattened or terete, subglabrous; often with flat, oblong, extra-floral nectaries on the lower surface of petiole and rhachis. Leaflets 7–9, opposite, 7–17 × 2.8–7.5 cm, elliptic to broadly oblong, apex narrowly attenuate to obtusely cuspidate, base obtuse to narrowly attenuate, glabrous above, puberulous to glabrous below, some-times glandular-punctate and striate; venation eucamptodromous or brochidodromous, midrib raised on the upper surface, secondaries 12–18 pairs, shallowly ascending, arcuate, parallel or slightly convergent, intersecondaries moderate to long, higher order venation obscure. Petiolule 2–5 mm long, subglabrous. **Inflorescences** 6–15 cm long, usually clustered around the shoot apex in the axils of caducous undeveloped leaves, paniculate with widely spreading branches, puberulous. Pedicel ca. 1 mm long. **Flowers** unisexual (plant monoecious or dioecious). Sepals 5, ca. 0.5 mm long, free or slightly fused, slightly imbricate, ciliate. Petals 5, 1.5–2.5 mm long, free, imbricate, glabrous. Stamens 10, partially fused (1/4 to 1/3 of their length) into a cyathiform or urceolate staminal tube 1–1.5 mm long, filament apex rounded or with 2 short appendages, densely hairy on both surfaces in the upper half; anthers ca. 0.5 mm long, hairy; antherodes of female flower shrunken, without pollen. Nectary a thick fleshy annulus surrounding the base of the ovary, glabrous. Ovary 3-locular, loculi uniovulate, glabrous. **Capsule** 1–2 cm long, broadly ellipsoid, apex obtuse, smooth, sericeous, tomentose or glabrous, 3-valved. **Seeds** 1–3, 0.8–1.5 cm long, completely surrounded by a thin fleshy arillode.

Field characters: Tree to 25 m high and 25 cm diameter. In central Amazonia there are two co-existing forms of this species, which differ in bole and fruit characters. Both are present in Reserva Ducke.

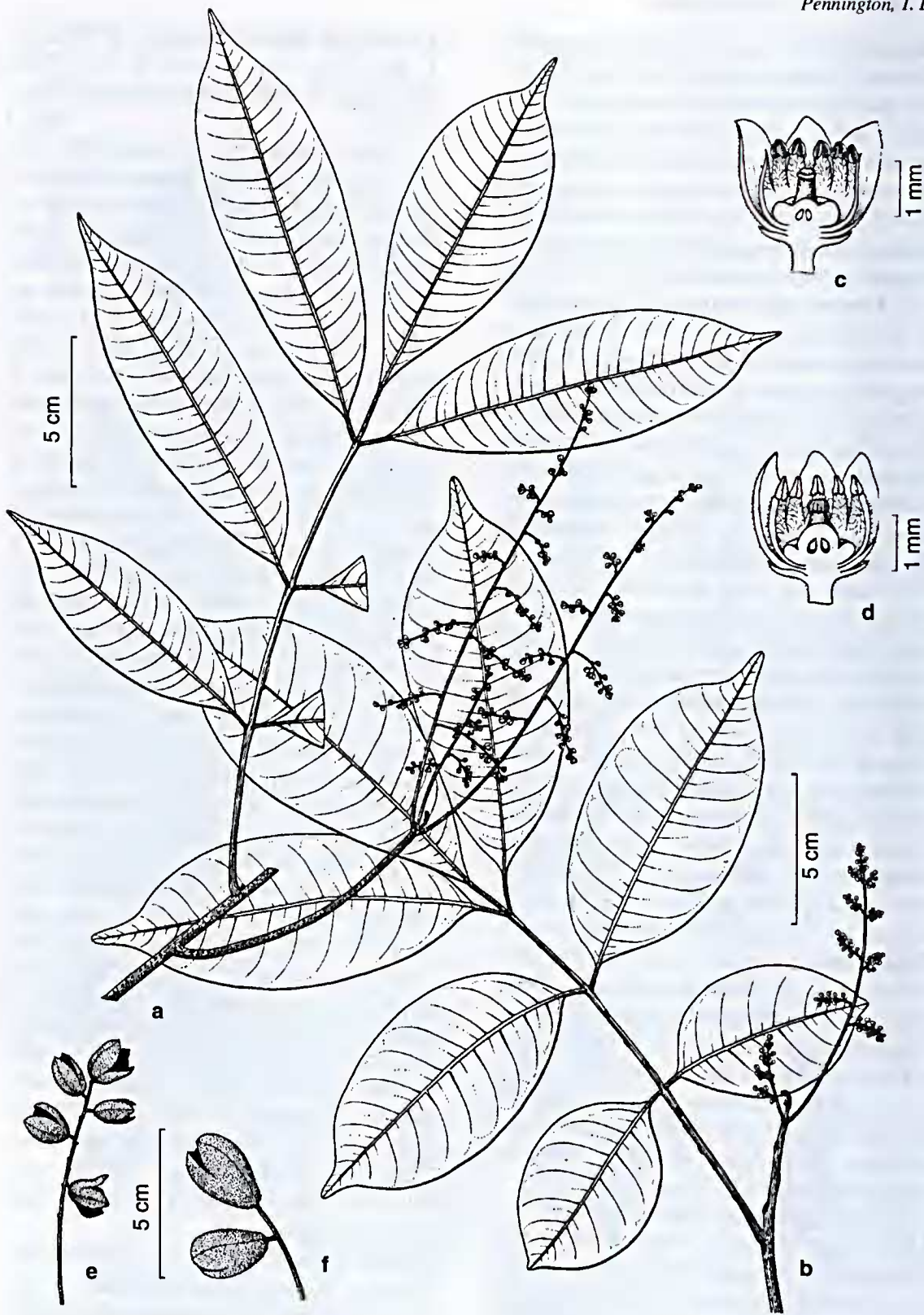


Figure 2 - *Trichilia micrantha* - a. habit (Pennington 9923); b. habit; c. male flower (Pennington 9932); d. female flower (Breteler 4771); e. fruit (Spruce 2286); f. fruit (Steyermark & Rabe 96274).

Form 1 has a round bole with smooth brown bark, extra-floral nectaries on the leaf petiole and rhachis, broad, elliptic subcoriaceous leaves and a sericeous fruit.

Form 2 has a fluted bole, scaling bark, no extra-floral nectaries, narrower oblong chartaceous leaflets and glabrous fruit.

Although quite distinct in central Amazonas, elsewhere in the range the distinctions break down and for this reason they are not given formal recognition. See Fl. Neotrop. 28: 72-73 (1981) for further discussion of this variation pattern.

The flowers of *T. micrantha* are greenish-white, with yellow anthers, and the fruit is yellowish with an orange-red arillode. Flowering in central Amazonas is recorded in March, April and July.

From northern Venezuela across Amazonia to Colombia, Peru and Bolivia. It is a species of non-flooded lowland forest.

10.VII.1995 (fr) Costa, M. A. S. et al. 311 (GINPA K MBM MGR U UB US); 19.VI.1965 (fl) Loureiro, A. & Coêlho, D. INPA 15523 (INPA); 28.IV.1988 (bd) Ramos, J. F. 1885 (BM COL INPA K MEXU MG SPF UEC VEN); 5.VII.1993 (fl) Ribeiro, J. E. L. S. et al. 1021 (INPA K MG MO NY RB SP); 15.V.1963 (fl) Rodrigues, W. & Coêlho, D. 5220 (INPA); 30.IV.1965 (fl) Rodrigues, W. & Coêlho, D. 6913 (INPA); 27.IV.1965 (fl) Rodrigues, W. & Monteiro, O. P. 6919 (INPA); 25.V.1995 (fr) Sothers, C. A. 472 (INPA K MG MO NY RB SP); 26.VII.1995 (fr) Sothers, C. A. & Assunção, P. A. C. L. 530 (BM COL IAN INPA K SPF UEC UFMT VEN); 26.VII.1995 (fr) Sothers, C. A. & Assunção, P. A. C. L. 531 (B F ICN INPA K MG P PUEFR VIC); 26.III.1996 (fl) Sothers, C. A. & Silva, C. F. 835 (B F IAN INPA K PPUEFR UFMT); 3.V.1968 (fl) Souza, J. A. INPA 21217 (INPA); 27.VI.1968 (fr) Souza, J. A. 29 (INPA); 21.VIII.1968 (fr) Souza, J. A. 103 (INPA); 15.III.1995 (fl) Vicentini, A. & Pereira, E. C. 905 (G IAN INPA K MBM R U UB US).

In spite of its variation *T. micrantha* is an easily recognized plant. The twigs have conspicuous white lenticels, the leaves dry a characteristic dark colour, the inflorescences are clustered together around the shoot apex, and the flowers have a prominent annular nectary surrounding the glabrous ovary and the ovary loculi are uniovulate.

1.4 *Trichilia rubra* C. DC. in Mart., Fl. bras. 11(1): 203. 1878; Pennington & Styles, Fl. Neotrop. 28: 75, fig. 9. 1981. **Fig. 3**

Trichilia guianensis Klotzsch ex C. DC. in A. & C. DC., Monogr. Phan. 1: 657. 1878.

Young shoots appressed puberulous at first, soon glabrous. Leaves imparipinnate, 9–12 cm long, petiole and rhachis semiterete, glabrous. Leaflets 7–9, opposite, 7–12 × 2–4 cm, oblong or elliptic, apex narrowly attenuate, base acute or narrowly attenuate, glabrous, sometimes glandular-punctate and -striate; venation eucamptodromous or brochidodromous, midrib slightly raised on the upper surface, secondaries 10–12 pairs, arcuate, convergent, impressed on the upper surface, intersecondaries long, tertiaries obscure, reticulate. Petiolule 4–6 mm long, slightly channelled, glabrous. **Inflorescence** axillary, 1–4 cm long, often several clustered on a short axillary shoot, sparsely puberulous. Pedicel ca. 1 mm long. **Flowers** unisexual (plant dioecious). Sepals 5, ca. 1 mm long, united for about 1/2 of their length, glabrous. Petals 5, 3.5–4 mm long, free, imbricate, glabrous. Stamens 10, partially fused (1/3 to 2/3 of their length) into a cyathiform or urceolate staminal tube 2.5–3 mm long, filaments apex rounded or with 2 short lobes, tube barbate in the throat; anthers ca. 0.75 mm long, with scattered hairs, antherodes of female flower slender, without pollen. Nectary absent. Ovary ovoid, 3-locular, loculi 1-ovulate, densely pubescent, style-head discoid. **Capsule** 2.5–3 cm long, ovoid or ellipsoid, apex and base obtuse to acute, smooth, puberulous, 3-valved, valves sometimes strongly reflexed. **Seed** solitary, 1.4–2.2 cm long, completely surrounded by a thin fleshy arillode.

Field characters: Tree to 25 m high, often flowering as a small treelet. Flowers scented, yellowish-green. Flowering in Reserva Ducke in December.

Throughout the Amazon region to the Guianas in the north and Peru and Bolivia in the west. The species is confined to riverbanks and forest on periodically or permanently flooded land.

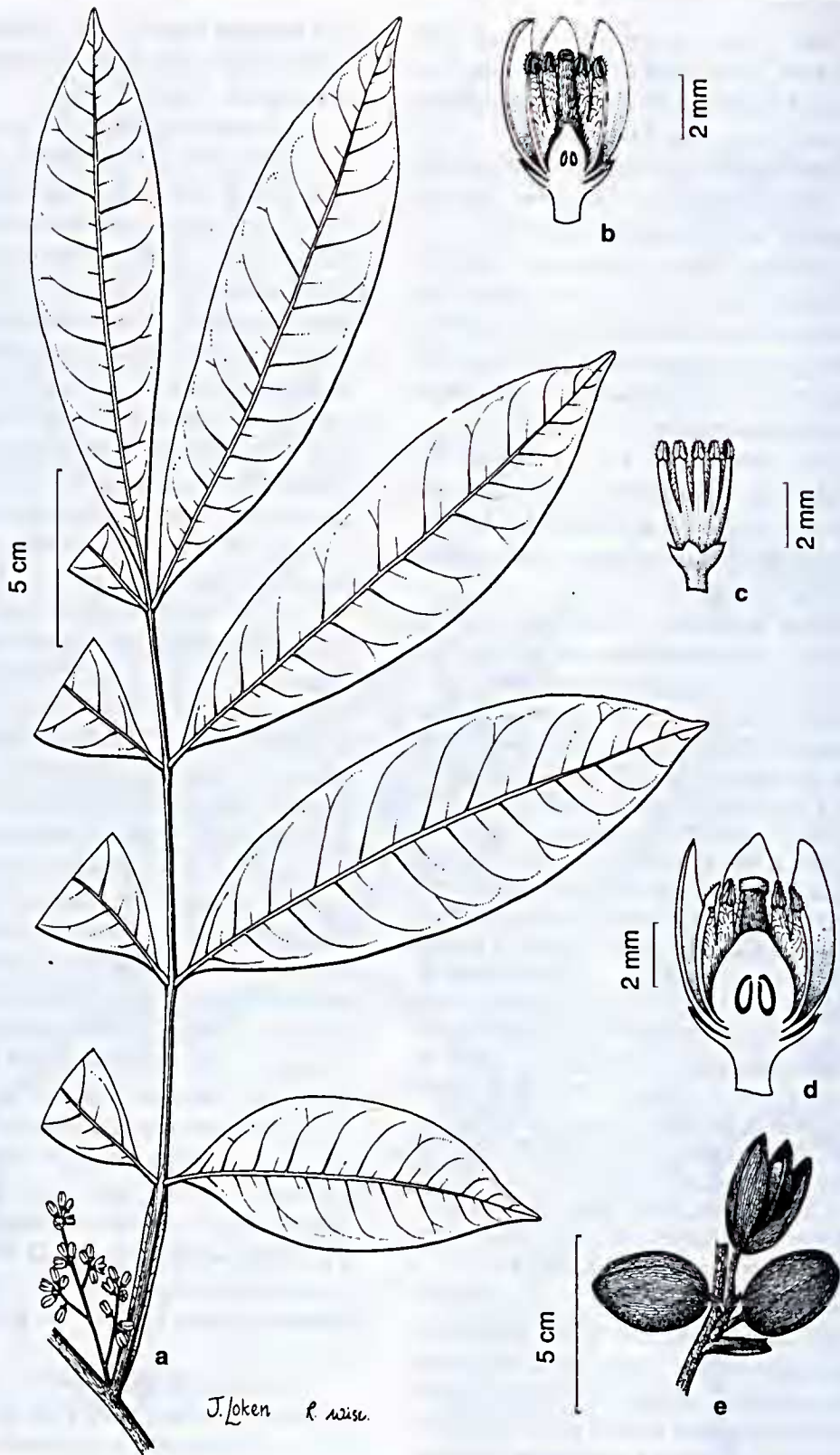


Figure 3 - *Trichilia rubra* - a. habit; b. male flower; c. staminal tube (FDBG D344); d. female flower (Persaud 176); e. fruit (Blanco 410).

10.XII.1993 (fl) *Vicentini, A. et al.* 395 (INPA K MG MONY SP).

Trichilia rubra is fairly isolated among the Amazonian *Trichilia* species with partially free staminal filaments. It lacks the lenticellate twigs of *T. micrantha* and its inflorescence is shorter and flowers larger. *Trichilia pallida* has 4-merous flowers and also differs in the presence of an annular disk, 2-ovulate ovary locules and in having fewer leaflets which tend to dry pale green.

1.5 *Trichilia pallida* Sw., Prodr. Veg. Ind. Occa. 67. 1788; Pennington & Styles, Fl. Neotrop. 28: 95, figs. 13, 14. 1981.

Trichilia macrophylla Benth., Hooker's J. Bot. Kew Gard. Misc. 3: 369. 1851.

Young shoots shortly pubescent at first, soon glabrous, lenticellate. Leaves imparipinnate, sometimes with a few trifoliolate, 3–10 cm long, petiole and rachis semiterete, puberulous to glabrous. Leaflets (3–)5, opposite, 8.5–14 × 3–6.5 cm, lower pair usually smaller than upper pair, variable in shape, from elliptic to oblanceolate or ovate, apex narrowly attenuate, base narrowly attenuate to obtuse, often asymmetrical, glabrous, sometimes sparsely glandular-striate; venation eucamptodromous or sometimes brochidodromous in the upper third, midrib flat or slightly raised on the upper surface, secondaries 9–11 pairs, arcuate, convergent, intersecondaries mostly absent, tertiaries oblique to reticulate. Petiolule 3–4 mm long, glabrous. **Inflorescence** axillary, 1–3 cm long, a small fasciculate thyse, sparsely puberulous. Pedicel *ca.* 0.5 mm long (above articulation). **Flowers** unisexual (plant dioecious). Sepals 4, *ca.* 1 mm long, fused for most of their length, sparsely puberulous outside. Petals 4, 5–6 mm long, apex acute, free, imbricate, subglabrous. Stamens 8, partially fused (1/3 to three quarters of their length) into a cyathiform or cylindrical staminal tube 4–4.5 mm long, filaments terminated by 2 slender appendages more or less equalling the anthers, glabrous outside, barbate or glabrous in the throat; anthers *ca.*

1 mm long, glabrous, antherodes of female flower slender, without pollen. Nectary annular, surrounding the base of the ovary, pubescent. Ovary 3-locular, loculi with 2 obliquely superposed ovules, stiffly pubescent. **Capsule** 1–2 cm long, ovoid to ellipsoid, densely pubescent with golden hairs, 3-valved, valves wrinkling horizontally on drying and sometimes reflexed. **Seed** usually 1 in each valve, 0.5–1 cm long, with an arillode covering most of the surface.

Field characters: Tree to 25 m high and 30 cm diameter, but often flowering as a small treelet, unbuttressed, bole sometimes fluted at the base, cylindrical above. Bark reddish brown, scaling and with lenticels in long vertical rows, slash pale whitish brown and fibrous. Flowers with pale green corolla and greenish-cream stamens. Capsule maturing yellowish-green, the seeds black and shining, partially surrounded by the red arillode. Flowering in central Amazonia has been recorded in April, August and December.

Throughout tropical America from Mexico to Paraguay and northern Argentina, in lowland and montane rain forest up to 2000 m altitude. In drier areas it is found in gallery forest.

14.VIII.1996 (fr) *Assunção, P. A. C. L. et al.* 368 (G INPA K MG MO NY R RB SP U); 9.VIII.1996 (fr) *Hopkins, M. J. G. et al.* 1602 (BM INPA K MBM MG UB US VEN); 12.XII.1968 (fl) *Prance, G. T. et al.* 9044 (INPA); 12.IX.1997 (fl) *Pruski, J. F. et al.* 3255 (INPA); 7.IV.1994 (fl) *Ribeiro, J. E. L. S. et al.* 1255 (INPA K MG MO NY R RB SP); 29.XI.1963 (fl) *Rodrigues, W.* 5549 (INPA); 2.I.1964 (fr) *Rodrigues, W. & Monteiro, O. P.* 5652 (INPA); 29.XII.1964 (fr) *Rodrigues, W. & Monteiro, O. P.* 6816 (INPA); 3.II.1965 (fr) *Rodrigues, W. & Monteiro, O. P.* 6854 (INPA); 11.V.1966 (fl) *Rodrigues, W. & Coêlho, D.* 7832 (INPA); 27.IX.1994 (fl) *Sothers, C. A. et al.* 177 (INPA); 18.XII.1996 (fl) *Sothers, C. A. & Silva, C. F.* 963 (G IAN INPA K MBM R U UB US).

A very distinctive species with (3–)5 leaflets drying pale cream, the short fasciculate inflorescence, 4-merous flowers, acutely tipped petals and small capsule with golden-brown indumentum.

1.6 *Trichilia septentrionalis* C. DC., in Mart. Fl. bras. 11(1): 220. 1878; Pennington & Styles, Fl. Neotrop. 28: 126, fig. 21. 1981. **Fig. 4**

Young shoots finely puberulous, indumentum persisting, without lenticels. Leaves imparipinnate, 17–25 cm long, petiole broadened and narrowly winged below, semiterete above, rhachis semiterete, finely puberulous. Leaflets 7–9, opposite or subopposite, 10–16 × 4.5–7 cm, the lowest leaflets smaller than the upper, broadly oblong to elliptic, apex narrowly attenuate, base narrowly cuneate to obtuse or rounded, upper surface glabrous, lower surface finely puberulous to glabrous, often faintly glandular-punctate and striate; venation eucamptodromous, midrib flat or slightly raised on the upper surface, secondaries 15–17 pairs, parallel, slightly arcuate, inter-secondaries absent, tertiaries oblique. Petiolule 5–8 mm long, puberulous. **Inflorescence** axillary, 18–25 cm long, a narrow, branched panicle, puberulous. Pedicel 0–0.5 mm long. **Flowers** unisexual (plant monoecious or ? dioecious). Sepals 5, 1.5–2.5 mm long, free, strongly imbricate, puberulous, ciliate. Petals 5(–7), 3–5 mm long, free, strongly imbricate, appressed puberulous to sericeous outside, glabrous inside. Stamens (8–)10, completely fused into a cyathiform or cylindrical staminal tube 2–4 mm long, margin with (8–)10 subulate appendages alternating with the anthers, sparsely hairy to barbate in the upper half; anthers 1–1.3 mm long, glabrous; antherodes of female flower shrunk, without pollen. Nectary annular, glabrous. Ovary, ovoid or conical, 3-locular, loculi 1-ovulate, pubescent, style-head minutely lobed. **Capsule** 2–3 cm long, oblong, ellipsoid or obovoid, apex rounded, base tapered, smooth, densely puberulous, 3-valved, valves opening widely and sometimes reflexing. **Seed** 1–2, 1–2 cm long, with a fleshy arillode which covers most of the seed.

Field characters: Tree to 25 m high and 25 cm diameter, bole sometimes fluted at the base. Bark grey to greyish-brown, longitudinally cracked and slightly scaling. The sweetly scented flowers are greenish-cream and the

fruit ripens reddish, with the seeds surrounded by a red arillode. Flowering in central Amazonas in April with the fruit ripening in July.

From Costa Rica across the whole of northern South America, from the foothills of the Andes in Peru to Maranhão. Usually found in lowland rain forest but ascending to 2000 m altitude in montane rain forest in Venezuela.

22.III.1994 (fr) Hopkins, M. J. G. et al. 1406 (INPA K MG MONY RB SP); 11.VII.1994 (bd) Nascimento, J. R. & Pereira, E. C. 532 (INPA K MG MONY RB SP); 14.IX.1987 (fr) Pruski, J. F. 3245 (INPA K MBM MG SPF UEC UFMT); 13.II.1964 (fr) Rodrigues, W. & Monteiro, O. P. 5732 (INPA); 22.IV.1964 (fr) Rodrigues, W. & Loureiro, A. 5777 (INPA); 28.V.1964 (fl) Rodrigues, W. & Loureiro, A. 5821 (INPA); 16.VI.1964 (fr) Rodrigues, W. & Loureiro, A. 5914 (INPA); 17.VII.1968 (fl) Souza, J. A. 46 (INPA); 13.V.1994 (fr) Vicentini, A. et al. 550 (G IAN INPA K R U UB).

Local name: Jitó.

Trichilia septentrionalis is distinctive in the field on account of the pale green leaf undersurface, the rather prominent parallel secondary venation, and the large erect, axillary panicles.

1.7 *Trichilia cipo* (A. Juss.) C. DC. in Mart. Fl. bras. 11(1): 214. 1878; Pennington & Styles, Fl. Neotrop. 28: 152, fig. 27. 1981. **Fig. 5**

Moschoxylum cipo A. Juss., Mém. Mus. Hist. Nat. 19: 239, 280. 1831.

Young shoots finely appressed puberulous at first, becoming glabrous, slightly scaling. Leaves pinnate, 10–20 cm long, petiole and rhachis semiterete, sparsely appressed puberulous. Leaflets 6–8, alternate to subopposite, 8.5–15 × 3–6.2 cm, the lowest leaflets smaller than the upper, elliptic, apex narrowly attenuate, base narrowly attenuate to obtuse, glabrous, sometimes glandular-punctate and -striate; venation eucamptodromous or brochidodromous, midrib flat or slightly raised on the upper surface, secondaries 10–12 pairs, straight or slightly arcuate, more or less parallel, intersecondaries moderate to long, tertiaries reticulate. Petiolule 1–2 mm long, subglabrous. **Inflorescence** axillary, 20–35 cm long, a lax-branched, narrowly pyramidal thyse, sparsely puberulous to subglabrous. Pedicel 0.5–1 mm long.

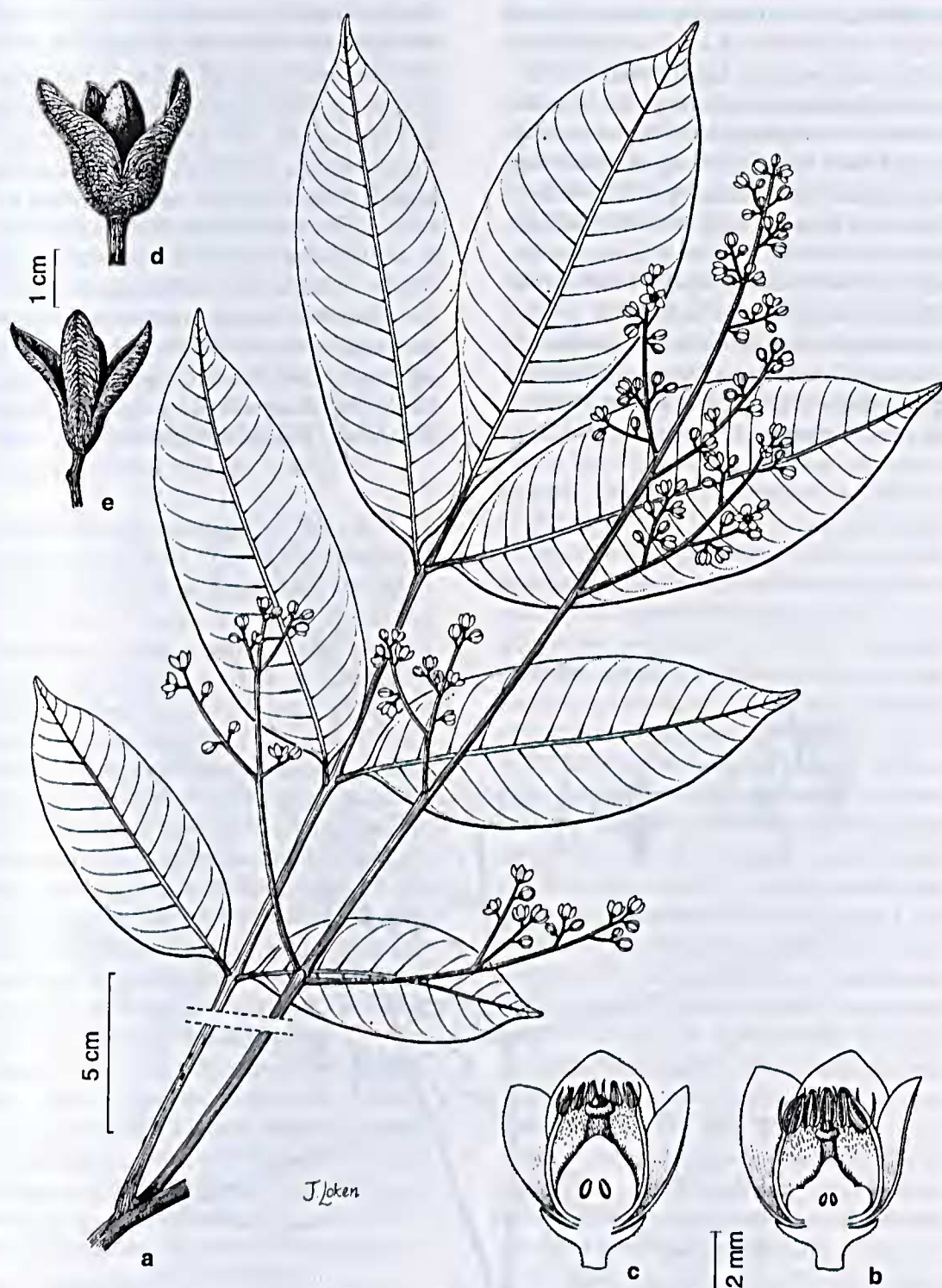


Figure 4 - *Trichilia septentrionalis* - a. habit (Pennington et al. 9927); b. male flower; c. female flower (Pennington et al. 9929); d. fruit (Fendler 138); e. fruit (Osmarino 37133).

Flowers unisexual (plant dioecious). Calyx patelliform, *ca.* 0.5 mm long, with 4–5 broad shallow lobes. Petals 4–5, *ca.* 2 mm long, fused for 1/3 to 2/3 of their length, valvate, finely appressed puberulous outside, glabrous inside. Stamens 7–8, completely fused into an urceolate staminal tube 1.5–1.75 mm long, margin bearing small subulate lobes alternating with the anthers, more or less glabrous, anthers 0.5–0.7 mm long, glabrous, antherodes of female flower slender, without pollen. Nectary absent. Ovary ovoid, 3-locular, loculi with 2 collateral ovules, puberulous, style-head capitate. **Capsule** 1.5–2 cm long, ellipsoid, apex obtuse or rounded, base tapered, finely appressed puberulous, 3-valved, valves remaining erect. **Seeds** 1–2, 1–1.5 cm

long, with a fleshy arillode which covers only the upper half of the seed.

Field characters: Tree to 20 m high, but often flowering as a treelet of 2–3 m. Bark smooth greyish- to reddish-brown, lenticellate, slash pinkish-orange. The scented flowers are greenish-cream, and the fruit matures a pale greyish colour, with the seed bearing a red arillode. The cotyledons are also red. Flowering in central Amazonas in September and October, with the fruit maturing in February.

From the Guianas to central and western Amazonia, along riverbanks and in low-lying areas over sand, also in campinarana forest.

10.XI.1994 (fl) *Assunção, P. A. C. L. 77* (ACRE IAN INPA K K NY US); 5.X.1994 (bd) *Sothers, C. A. 203*

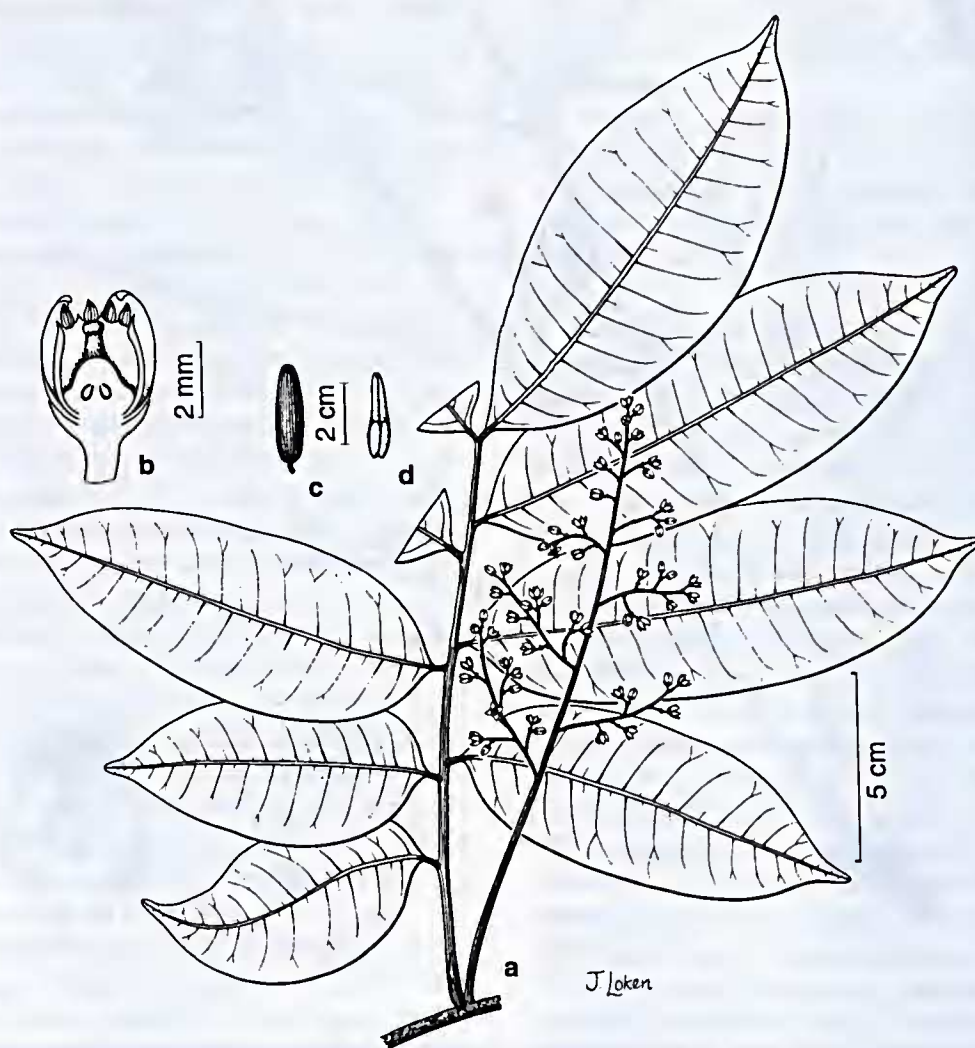


Figure 5 - *Trichilia cipo* - a. habit; b. flower; c. fruit; d. seed with apical arillode (Prance & Pennington 1973).

(BM INPA K MBM MG UB US); 27.X.1994 (fl) *Sothers, C. A. & Silva, C. F.* 247 (GINPA K MG MO NY R RB SP U); 27.X.1995 (fl) *Sothers, C. A. & Assunção, P. A. C. L.* 652 (GH IAN ICN INPA K S UPGB VIC W); 7.XI.1995 (fl) *Sothers, C. A. et al.* 670 (COL F INPA K MG SPF UEC UFM T VEN); 7.XII.1995 (fl) *Sothers, C. A. et al.* 704 (B GH IAN ICN INPA K PPUEFR VIC); 23.I.1996 (fr) *Sothers, C. A. & Pereira, E. C.* 784 (G IAN INPA K MBM UB US); 18.IX.1997 (bd) *Souza, M. A. D. et al.* 416 (INPA K MEXU); 5.II.1995 (fr) *Vicentini, A. et al.* 852 (INPA K MG MO NY R RB SP U).

A rather nondescript species characterized by the long slender inflorescence, very small flowers and smooth puberulous fruit, with the seed only partially covered by the fleshy arillode. It lacks the reduced basal leaflets of other small-flowered *Trichilia* such as *T. pleeana*.

1.8 *Trichilia* aff. *poepigii* C. DC., in A. & C. DC., Monogr. Phan. 1: 685. 1878; Pennington & Styles, Fl. Neotrop. 28: 162, fig. 29. 1981.

Young shoots finely appressed puberulous, soon glabrous and densely lenticellate. **Leaves** pinnate, 4–7 cm long, petiole and rhachis semiterete, glabrous. Leaflets 5, alternate, 9.5–12.5 × 3–3.5 cm, elliptic to oblong-elliptic or lanceolate, apex narrowly attenuate, base acute to narrowly attenuate, often asymmetrical, glabrous; venation brochidodromous, midrib slightly raised on the upper surface, secondaries 11–13 pairs, more or less parallel, arcuate, intersecondaries long, tertiaries reticulate. Petiolule 3–4 mm long, glabrous. **Inflorescence** axillary, 8–10 cm long, slender, with a few short branches, subglabrous. **Flowers** not seen. **Capsule** 3.5–4.5 cm long, narrowly ellipsoid, apex and base tapered and acute, smooth, densely puberulous, 3-valved. **Seed** solitary, ca. 1.8 cm long, partially surrounded in a fleshy arillode, while it is developed only at the apex and along the adaxial surface.

Field characters: A small treelet with pale green fruit, collected in February.

Known only from a single collection in central Amazonian Brazil, where it occurs in lowland rain forest on non-flooded land.

Not recorded from Reserva Ducke.

AMAZONAS: Manaus, Distrito Agropecuário, Fazenda Porto Alegre, Reserve 3304, *Pacheco et al.* 214 (K).

This plant may be conspecific with *T. poepigii* (a western Amazonian species) but without flowers it is impossible to be sure. It shares with *T. poepigii* the lack of reduced basal leaflets on the petiole, the same number of leaflets and both fruit and seed structure.

1.9 *Trichilia* aff. *schomburgkii* C. DC., in A. & C. DC., Monogr. Phan. 1: 695. 1878; Pennington & Styles, Fl. Neotrop. 28: 165, figs. 30, 31. 1981.

Young shoots appressed puberulous at first, soon glabrous, lenticellate. **Leaves** pinnate, 6–10 cm long, petiole and rhachis semiterete, sparsely appressed puberulous to glabrous. Leaflets 4–5, 9.5–15 × 3–5.7 cm, lowest leaflet smaller than the upper, elliptic, apex narrowly acuminate, base narrowly attenuate, lowest leaflet with asymmetrical base, glabrous, not glandular-punctate or -striate; venation eucamptodromous, midrib raised on the upper surface, secondaries 10–11 pairs, slightly convergent, slightly arcuate; intersecondaries short, tertiaries reticulate. Petiolule 2–3 mm long, subglabrous. **Inflorescence** a narrow panicle 5–7 cm long, clustered around the shoot apex in the axils of newly developing leaves, giving the appearance of a compound terminal inflorescence, subglabrous. Pedicel ca. 1 mm long above the articulation. **Flowers** probably unisexual. Calyx ca. 1 mm long, patelliform, margin obscurely lobed, sparsely puberulous outside. Petals 5, ca. 4.5 mm long, fused for about 1/5 of their length, valvate, reflexing, with scattered appressed hairs outside, glabrous inside. Stamens 10, completely united into a staminal tube ca. 4 mm long, tube tapering from near base to apex, margin bearing small subulate lobes alternating with the anthers, with scattered appressed hairs outside, sparsely pubescent inside; anthers (antherodes) 0.75–1 mm long, slender, not dehiscent, without pollen, glabrous. Nectary absent. Ovary conical, 3-locular, loculi with 2 collateral ovules densely stiff hairy, stylar head capitate. **Fruit** not seen.

Field characters: Tree to 12 m high with reddish-brown scaling bark, inner bark laminated, brown. The flowers have a green corolla and white staminal tube. Flowering in July.

14.XII.1995 (fl) Assunção, P. A. C. L. & Pereira, E. C. 262 (INPA K MG MO NY R RB SP U); 21.I.1998 (fl) Gomes, F. P. & Pereira, E. C. Silva, C. F. 9 (K); 7.VII.1993 (fl) Ribeiro, J. E. L. S. et al. 1049 (COL FINPA K MG SP FUFMT VEN); 2.I.1998 (fl) Souza, M. A. D. et al. 548 (BM GIAN INPA K MBM UB UEC US).

This plant is undoubtedly closely related to *T. schomburgkii* and shares the same inflorescence and floral structure. It differs principally in lacking the characteristic reduced basal leaflets of *T. schomburgkii*, and its leaflets are generally smaller. Further flowering and fruiting material are required before it can be placed with certainty.

1.10 *Trichilia micropetala* T. D. Penn., Fl. Neotrop. 28: 172, fig. 32. 1981. Fig. 6

Young shoots puberulous, becoming glabrous, with a few lenticels. Leaves pinnate, 2.5–4 cm long, petiole and rhachis semiterete, puberulous. Leaflets 5, alternate, 3.2–7 × 1.5–3 cm, elliptic, apex narrowly acuminate, base narrowly attenuate, with 2 additional pairs of greatly reduced leaflets clasping the base of the petiole, these 0.6–1 cm long, suborbicular, subglabrous or minutely puberulous below, sometimes glandular-punctate and -striate, venation mostly brochidodromous, midrib raised on the upper surface, secondaries 9–10 pairs, arcuate, convergent, intersecondaries short to moderate, tertiaries reticulate. Petiolule 1–1.5 mm long, puberulous. **Inflorescence** axillary, ca. 10 cm long, a much branched panicle, sparsely puberulous. Pedicel ca. 1 mm long above the articulation. **Flowers** unisexual (plant dioecious). Calyx patelliform, ca. 0.75 mm long, with 5 obtuse lobes, subglabrous. Petals 4, ca. 2 mm long, fused to about halfway, valvate, sparsely appressed puberulous outside. Stamens 7(–8), completely fused in a staminal tube ca. 1 mm long, the margin bearing subulate appendages alternating with the anthers, glabrous outside, sparse long hairs in the throat; anthers 0.5–0.6 mm long, glabrous; antherodes of female flower shrunken, without pollen. Disk

(nectary) absent. Ovary broadly ovoid, 3-locular; loculi with 2 collateral ovules, appressed puberulous, style-head capitate. **Fruit** unknown.

Field characters: Tree to 20 m high, often flowering as a small treelet. Bark rough, lenticellate, scaling in irregular pieces. Flowers greenish-white. Flowering in central Amazonia in November and December.

Known from Pará, Amapá and central Amazonia where it occurs in rainforest on non-flooded land.

5.XII.1995 (fl) Costa, M. A. S. et al. 437 (BM INPA K K MBM MG NY UB UEC US VEN); 9.XI.1995 (fl) Sothers, C. A. & Silva, C. F. 674 (G INPA K MG MOR RB SP U).

Trichilia micropetala is easily recognized by its small leaves with dimorphic leaflets and the small flowers. The nearest relative is *T. lecointei*, which has not yet been recorded from central Amazonia. The latter has larger leaves with more numerous leaflets with an asymmetrical base and large flower with more or less free petals.

1.11 *Trichilia bullata* T. D. Penn., Fl. Neotrop. 28: 179, fig. 35. 1981. Fig. 7 a-c

Young shoots shortly tomentose, indumentum persistent. Leaves imparipinnate, 15–35 cm long, petiole and rhachis semiterete, crisped-pubescent. Leaflets 7–11 opposite or subopposite, 14–25 × 4–7.5 cm, oblong, apex narrowly acuminate, base acute to rounded or truncate, with 2 additional pairs of greatly reduced leaflets clasping the base of the petiole, these varying in shape from orbicular to subulate, 0.5–3.5 cm long; midrib pubescent above, lamina glabrous, lamina sparsely short-pubescent below, glandular-punctate and -striate, venation eucamptodromous, midrib slightly raised on upper surface, secondaries 20–30 pairs, parallel, slightly arcuate, intersecondaries short or absent, tertiaries few, oblique to reticulate. Petiolule 2–5 mm long, shortly pubescent. **Inflorescence** axillary, 30–60 cm long, a narrow panicle, pubescent. Pedicel 1–1.5 mm long. Calyx cyathiform, 1.5–2.5 mm long, 4–5-lobed, pubescent. Petals 4–5, ca.

6 mm long, fused for 1/3 to 2/3 of their length, valvate, appressed puberulous outside, glabrous inside. Stamens 7–10, completely fused in a cylindrical staminal tube 4–4.5 mm long, the margin bearing subulate or lanceolate appendages alternating with the anthers, glabrous outside, sparsely pilose inside; anthers 0.8–1 mm long, glabrous. Nectary absent. Ovary conical, 3-locular, loculi with 2 collateral ovules, pubescent, style-head capitate or truncate. **Fruit** unknown. **Field characters:** Tree to 15 m high with greyish, finely fissured bark. Flowers greenish-white, in November and December.

Central and western Amazonian Brazil, where it occurs in non-flooded rain forest.

Not recorded from Reserva Ducke.

AMAZONAS: Manaus, *Francisco & Dionísio* 3173 (FHO INPA); Humaitá *Krukoff* 6908 (A BMF G K MO S); Manaus to Porto Velho, km 510, *Pennington et al.* 9968 (FHO INPA K MO).

Trichilia bullata is related to *T. schomburgkii*, but distinguished from it by the short dense indumentum on the young parts and lower leaf surface, by the numerous parallel secondary veins and narrow inflorescence.



Figure 6 - *Trichilia micropetala* - a. habit with male inflorescence (*Pires et al.* 51223); b. male flower (*Pires & Cavalcante* 52659); c. habit with female inflorescence; d. female flower (*Egler & Irwin* 46479)

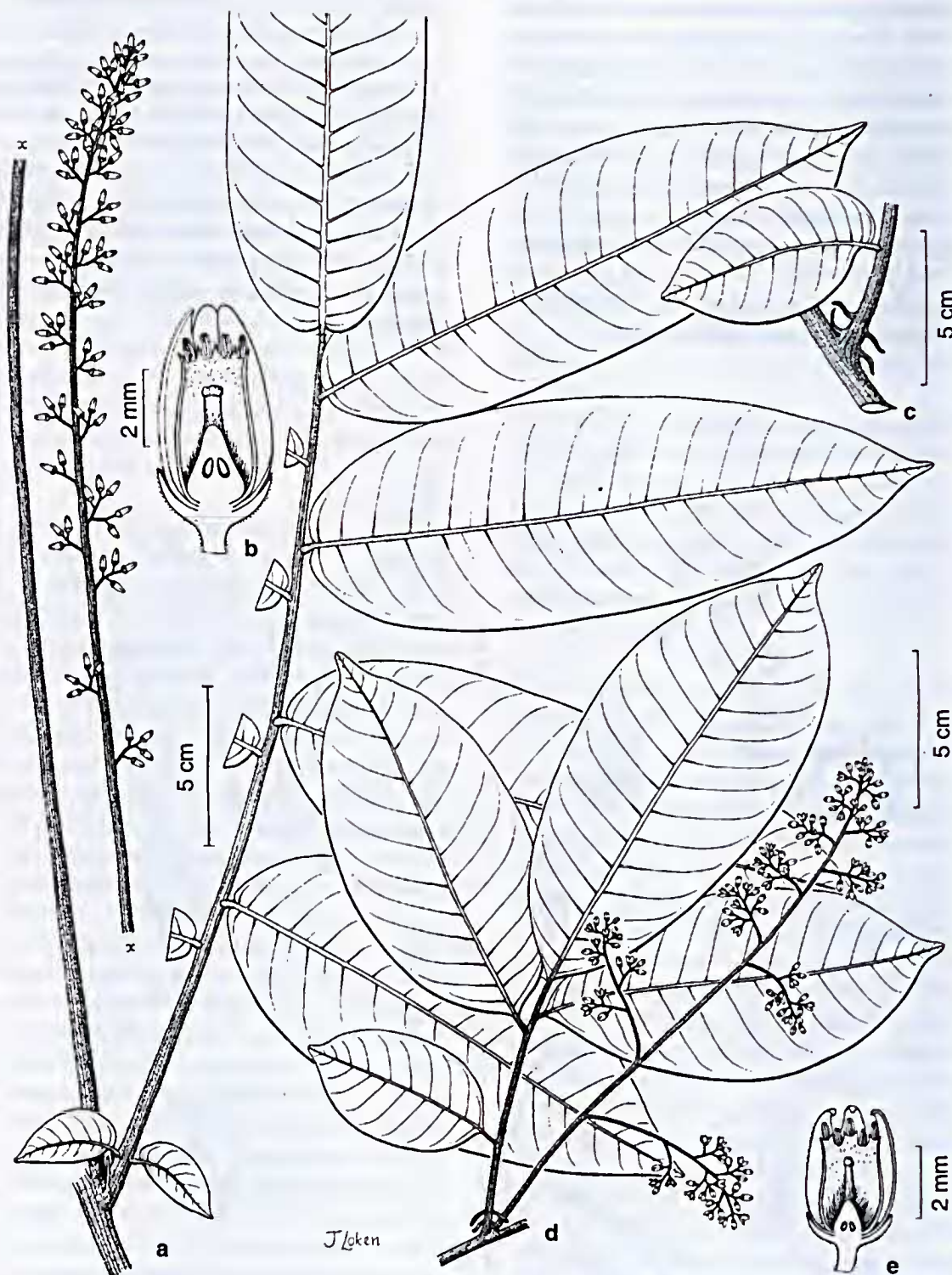


Figure 7 - a-c. *Trichilia bullata* - a. habit; b. flower (Krukoff 7213); c. reduced basal leaflets (Pennington et al. 9987). d-e. *T. areolata* - d. habit; e. flower (Coelho & Mello 3007).

1.12 *Trichilia pleeana* (A. Juss.) C. DC., in Mart., Fl. bras. 11(1): 215. 1878; Pennington & Styles, Fl. Neotrop. 28: 198, fig. 27. 1981.

Fig. 8

Moschoxylum pleeanum A. Juss., Mém. Mus. Hist. Nat. 19: 239, 281. 1831.

Young shoots sparsely appressed puberulous at first, soon glabrous, with pale lenticels. Leaves pinnate, 10–15 cm long, petiole and rachis slightly flattened and expanded below the leaflet insertion, glabrous. Leaflets 5–7, alternate, 9–15 × 3.5–5 cm, elliptic to oblanceolate, apex acuminate, base acute to narrowly attenuate, with 2–3 additional pairs of greatly reduced leaflets near the base of the petiole, these 0.5–2 cm long, ovate with

an asymmetrical base to subulate, glabrous, glandular-punctate and -striate; venation eucamptodromous to brochido-dromous, midrib prominent on the upper surface, secondaries 10–12 pairs, slightly arcuate, slightly convergent, intersecondaries short to moderate, tertiaries reticulate. Petiolule 3–5 mm long, subglabrous. **Inflorescence** axillary, 15–20 cm long, a much-branched thyrses, subglabrous. Pedicel 0.5–1.5 mm long. **Flowers** unisexual (plant dioecious). Calyx patelliform or cyathiform, ca. 1 mm long, deeply 5-lobed, sparsely puberulous outside. Petals 5, ca. 3 mm long, fused for 1/4 to 1/2 of their length, valvate, with scattered minute appressed hairs outside, glabrous inside. Stamens 9–10, completely fused in a staminal tube 1.5–

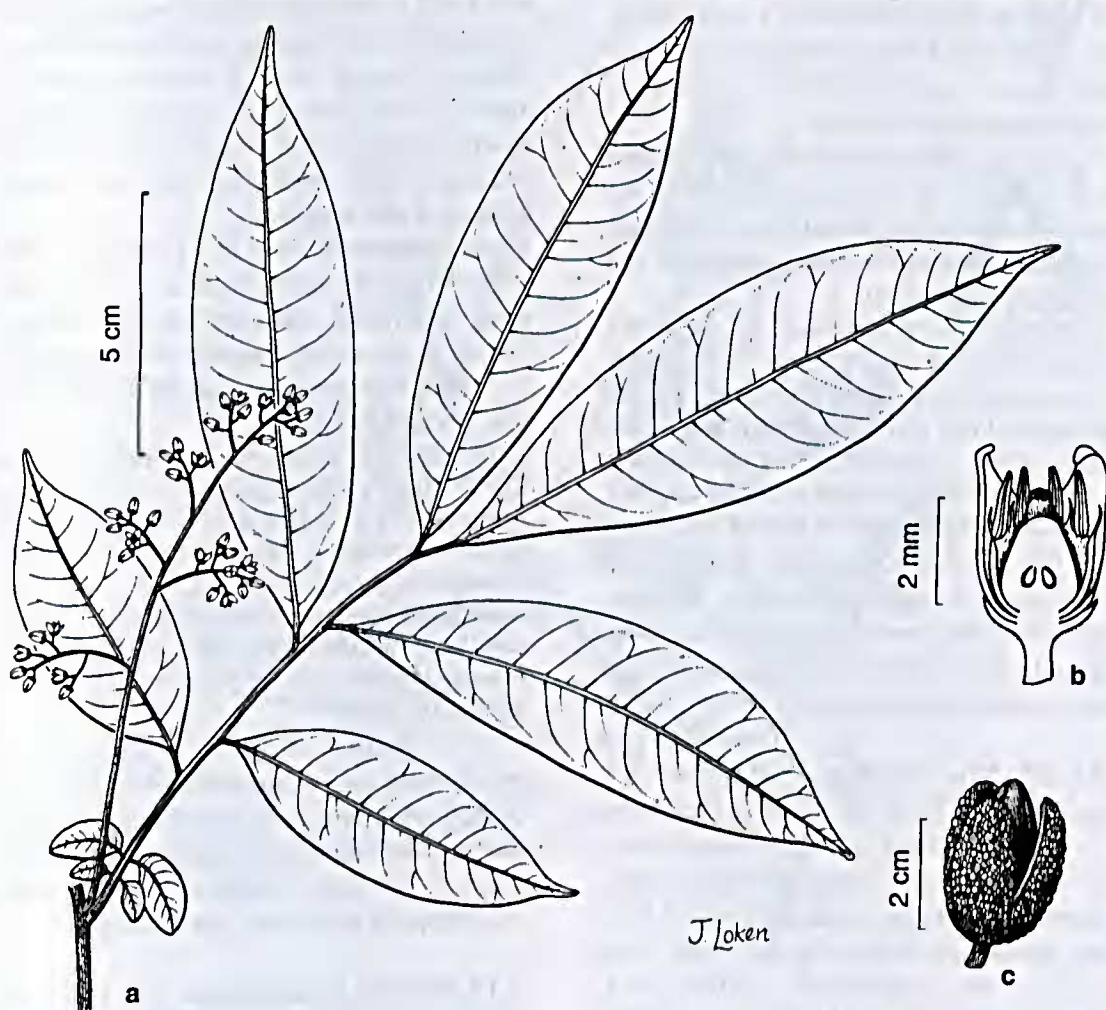


Figure 8 - *Trichilia pleeana* - a. habit (FDBG 5799); b. flower (Ule 6618); c. fruit (Pennington et al. 10168).

2 mm long, the margin bearing subulate lobes alternating with the anthers, glabrous outside, pubescent inside; anthers *ca.* 1 mm long, glabrous; antherodes of female flower slender, without pollen. Nectary absent. Ovary ovoid, 3-locular, loculi with 2 collateral ovules, puberulous, style-head capitate. **Capsule** 1.5–3 cm long, ovoid to globose, verrucose, glabrous, 3-valved, valves remaining erect. **Seeds** 1–2, 1–1.5 cm long, completely surrounded by a soft fleshy arillode. **Field characters:** Tree to 30 m high, larger specimens with small buttresses and bole fluted near base. Bark grey, scaling in long thin irregular sheets exfoliating from the base. Flowers greenish-yellow and ripe fruit a dark glossy green. The seed is surrounded by an orange arillode. The reduced basal leaflets are a conspicuous feature in the field, but they often fall off on drying. Flowering in central Amazonia from October to December, fruiting in March.

From southern Costa Rica across northern South America to the Guianas, western and central Amazonia and coastal Brazil. A species of lowland rain forest on both non-flooded and periodically flooded land.

11.X.1995 (fl) *Sothers, C. A. & Pereira, E. C.* 622 (INPA KMG MONYRB SPUUS); 1.XII.1997 (fl) *Souza, M. A. D. & Assunção, P. A. C. L.* 468 (BM G INPA K MBM MGUB UEC VEN); 1.XII.1997 (fl) *Souza, M. A. D. de & Assunção, P. A. C. L.* 469 (INPAK); 9.X.1997 (fl) *Souza, M. A. D. & Pereira, E. C.* 490 (K); 11.III.1998 (fr) *Souza, M. A. D. et al.* 560 (IAN INPA K MONYRB SPUUB).

This species is somewhat similar to *T. schomburgkii*, but has smaller flowers, alternate leaflets and much less conspicuous reduced basal leaflets. The green verrucose glabrous capsule is diagnostic.

1.13 *Trichilia areolata* T. D. Penn., Fl. Neotrop. 28: 208, fig. 35. 1981. **Fig. 7 d-e**

Young shoots coarsely pubescent, becoming glabrous, rough and lenticellate. Leaves 1–3-foliolate or pinnate, up to 8.5 cm long, petiole semiterete, rhachis terete, both sparsely long-pubescent. Leaflets 1–5, alternate to opposite, 7–14 × 4–5.5 cm, elliptic, apex obtusely cuspidate to shortly attenuate, base cuneate to obtuse, with 1–2 additional pairs

of vestigial linear-subulate leaflets at the base of the petiole, these 0.5–1 cm long; coarsely pubescent with scattered hairs on the lower surface, glandular-punctate and -striate; venation eucamptodromous, midrib raised on the upper surface, secondaries 7–15 pairs, arcuate, parallel or slightly convergent, intersecondaries mostly absent, tertiaries forming a prominent reticulum. Petiolule 3–4 mm long. **Inflorescence** axillary, 10–20 cm long, an irregularly branched panicle, coarsely pubescent. Pedicel 0.5–1.5 mm long. Calyx cyathiform, 1–1.5 mm long, 5-toothed, subglabrous. Petals 5, 3–3.5 mm long, free, valvate, strigillose outside, glabrous inside. Stamens 9–10, completely fused in a staminal tube 1.5–2 mm long, the margin bearing slender appendages alternating with the anthers, glabrous outside, crisped pubescent inside; anthers 0.6–0.7 mm long, glabrous. Nectary absent. Ovary ovoid, 2–3-locular, loculi with 2 collateral ovules, densely stiff-hairy, style-head capitate. **Fruit** unknown.

Field characters: Tree to 12 m high, often with unifoliolate and trifoliolate leaves on the same individual. Flowers greenish-white. Flowering in central Amazonia in November.

Pará and Amazonas where it occurs in non-flooded forest.

13.III.1998 (fr) *Assunção, P. A. C. L. et al.* 819 (INPA K MG MO NY RB SP U UB); 13.III.1998 (fr) *Assunção, P. A. C. L. et al.* 821 (K); 24.XI.1997 (fl) *Costa, M. A. S. et al.* 818 (INPA); 24.XII.1997 (fl) *Costa, M. A. S. et al.* 819 (INPA).

Additional specimens: AMAZONAS: Manaus, *Coelho & Mello* 3003, 3007 (FHO INPA); Manaus to Itacoatiara km 190, *Pennington et al.* 9948 (FHO INPA).

A distinct species related to *T. micropetala* and *T. inaequilatera*, but its 1–5-foliolate leaves with prominent reticulate higher order venation are unlike either of those species. The linear-subulate reduced leaflets at the base of the petiole are distinctive.

1.14 *Trichilia inaequilatera* T.D. Penn., Fl. Neotrop. 28: 209, fig. 44. 1981. **Fig. 9**

Young shoots coarsely pubescent, becoming glabrous, lenticellate and scaling.



Figure 9 - *Trichillia inaequilatera* - a. habit with male inflorescence (Wurdack & Adderley 43002); b. male flower (Revilla 518); c. habit with female inflorescence; d. female flower (Revilla 517).

Leaves pinnate, 6–16 cm long, petiole and rachis semiterete, coarsely pubescent. Leaflets 6–10, alternate to opposite, 7–15 × 2.5–5 cm, elliptic or lanceolate, apex acute to narrowly attenuate, base acute to rounded or truncate, usually asymmetrical, with 1 additional pair of greatly reduced leaflets near the base of the petiole, these 0.7–2 cm long, ovate; upper surface subglabrous, lower surface with sparse coarse hairs on midrib and veins; generally not glandular-punctate or -striate; venation eucamptodromous, midrib slightly sunken on the upper surface, secondaries 11–15 pairs, slightly arcuate, parallel or slightly convergent, intersecondaries short, tertiaries reticulate. Petiolule 0–2 mm long. **Inflorescence** axillary, 10–20 cm long, a slender or pyramidal thyse, coarsely pubescent. Pedicel 0.25–1 mm long. **Flowers** unisexual (plant dioecious). Calyx rotate or patelliform, 1–2 mm long, 5-lobed, pubescent outside. Petals 5, 2–4 mm long, free, valvate, appressed pubescent outside, glabrous inside. Stamens 8–10, completely united in a staminal tube 1.5–2.5 mm long, the margin bearing acute lobes alternating with the anthers, glabrous outside, sparsely hairy or glabrous inside; anthers 0.5–1 mm long, glabrous; antherodes in female flower slender, without pollen. Nectary absent. Ovary broadly conical, 3-locular, loculi with 2 collateral ovules, densely stiff-pubescent, style-head capitate. **Capsule** (immature) *ca.* 1 cm long, ellipsoid, apex rounded, apiculate, smooth, tomentose, 3-valved. **Seed** not seen.

Field characters: Tree to 25 m high and 35 cm diameter, with smooth grey bark. Flowers yellowish-white. Flowering in central Amazonas in September and October.

Western and central Amazonia to Venezuela, mostly in periodically flooded lowland forest and along riverbanks.

Not recorded from Reserva Ducke.

AMAZONAS: Paraná do Autaz-Mirim, Mello 46 (FHO INPA); Município Fonte Boa, Foz do Rio Juruá, Cid *et al.* 7370 (INPA K); Humaitá, Krukoff 8485 (A BMFK MONY P).

Trichilia inaequilatera is related to *T. areolata*, but differs from it in the more numerous

leaflets with an asymmetrical base, and in the shape and size of the reduced basal leaflets.

1.15 *Trichilia singularis* C. DC., in Mart., Fl. bras. 11(1): 217. 1878; Pennington & Styles, Fl. Neotrop. 28: 218, fig. 45. 1981. Fig. 10

Young shoots appressed puberulous, soon glabrous and densely lenticellate. **Leaves** unifoliolate, trifoliolate or pinnate, 6–18 cm long (petiole of unifoliolate leaves 1–3 cm long), petiole and rachis semiterete, appressed puberulous. Leaflets 1–8, opposite to alternate, 10–20 × 3–7 cm (lateral leaflets of trifoliolate leaves much smaller), elliptic, oblong or oblong-lanceolate, apex narrowly attenuate to acute, base acute to attenuate, glabrous above, with sparse appressed medifixed hairs below, usually not glandular-punctate or -striate; venation eucamptodromous, midrib usually slightly prominent above, secondaries 12–18 pairs, straight or arcuate, parallel or slightly convergent, intersecondaries short to moderate, tertiaries few, oblique. Petiolule 1–3 mm long. **Inflorescence** axillary, 1–7 cm long, a raceme or slender panicle, appressed puberulous. Pedicel 0.5–1 mm long. **Flowers** unisexual (plant dioecious). Calyx cyathiform or patelliform, 0.5–1 mm long, 5-lobed, appressed puberulous. Petals 5, 2.5–3 mm long, fused in the lower half or free, valvate, appressed hairy outside, glabrous inside. Stamens 10, completely fused in a staminal tube 1–1.5 mm long, the margin bearing short subulate lobes alternating with the anthers, glabrous or sparsely hairy in the throat; anthers 0.5–0.7 mm long, glabrous; antherodes of female flower shrunken, without pollen. Nectary absent. Ovary 2-locular, loculi with 2 collateral ovules, densely appressed puberulous, style-head capitate. **Capsule** 1.5–2 cm long, narrowly ovoid to ellipsoid, apex acute to rounded, smooth, granular-papillose with some appressed hairs, 2-valved. **Seeds** 1–2, 1.2–1.4 cm long, completely surrounded by a thin fleshy arillode.

Field characters: Treelet or small tree to 10 m high with smooth reddish bark. Flowers greenish-white. Flowering in central Amazonas July to October.

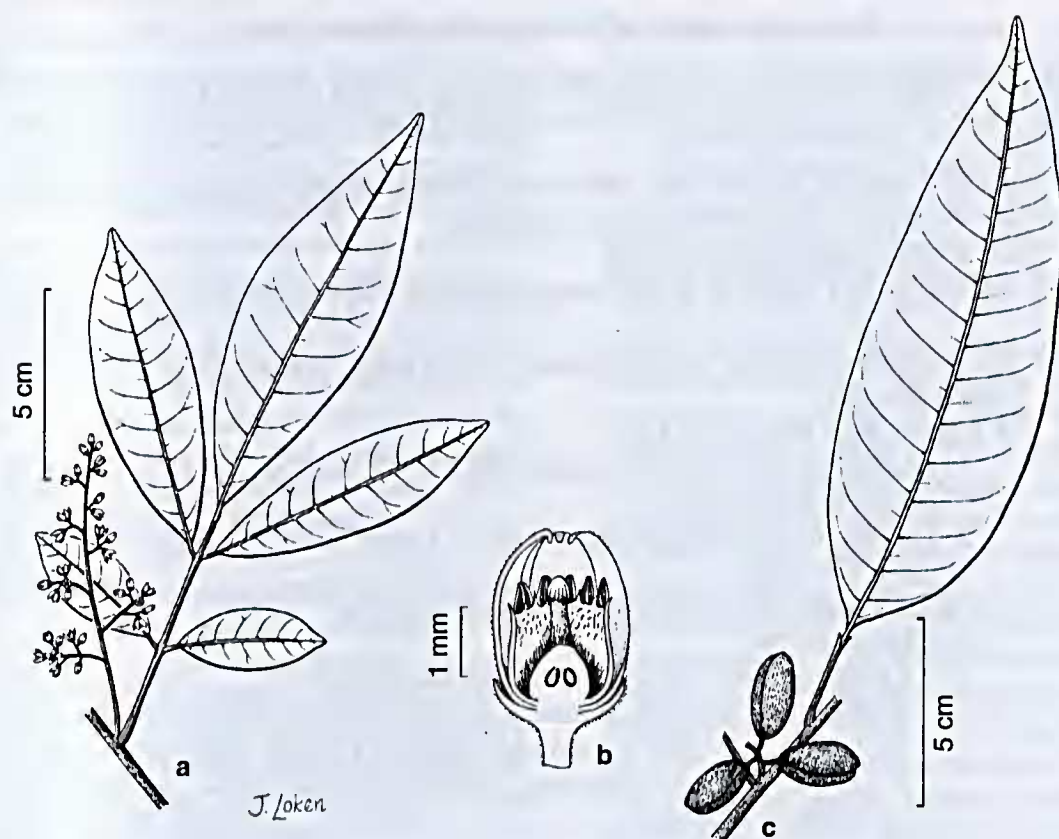


Figure 10 - *Trichilia singularis* - a. habit (Aristeguieta & Zabala 7069); b. male flower (Prance et al. 2573); c. unifoliolate leaf and fruit (Dahlgren & Sella 208).

Common on the flood plain of the Amazon and Orinoco, usually in seasonally flooded forest but occasionally in permanently flooded igapó forest.

Not recorded from Reserva Ducke.

AMAZONAS: Paraná do Careiro, Ducke 2019 (ANY); Manaus, Furo do Paracuuba, Rodrigues 27736 (FHO).

Although this species is very variable in its leaf morphology, it can always be recognized (with a lens) by the indumentum of pale appressed medifixed hairs on the lower leaflet surface. The rather large unifoliolate leaves combined with the short slender inflorescence are also distinctive.

2. *Guarea*

Guarea Allam. ex L., Mant. 150: 228. 1771, nom. cons. Huber, J., Bol. Mus. Paraense Hist. Nat. 3: 241. 1902.

Trees or treelets. Indumentum of simple hairs. **Leaves** pinnate, nearly always (except

G. silvatica) with a terminal bud usually showing intermittent growth, leaflets sometimes glandular-punctate or -striate. **Flowers** unisexual (plant dioecious). **Inflorescence** a panicle, raceme or spike. Calyx shallowly to deeply 3–7-lobed. Petals 4–6, free, nearly always valvate. Filaments completely united in a staminal tube, with an entire, crenate or slightly lobed margin; anthers 8–12, inserted within the throat of the staminal tube. Nectary short- to long-stipitate, expanded to form a collar at the base of the ovary. Ovary 2–10-locular, loculi with 1–2 superposed ovules, style-head discoid. **Fruit** a 2–10-valved loculicidal capsule, valves 1–2-seeded, valves leathery to woody. **Seed** fleshy, with thin fleshy sarcotesta. Embryo nearly always with superposed cotyledons.

About 45 species in tropical America and 5 in Africa. Ten species occur in the vicinity of Manaus, of which 8 occur in Reserva Ducke.

Key to the species of *Guarea* of the Manaus area

1. Leaves without a dormant terminal bud, inflorescence a slender glabrous panicle to 120 cm long, petals imbricate, capsule 2(-3)-valved, 3.5-5 cm long, constricted between the seeds 8. *G. silvatica*
1. Leaves with a dormant terminal bud, inflorescence shorter, usually branched, petals valvate, capsule 4-6-valved, not constricted between the seeds.
 2. Ovary 4(-5)-locular, locules 1-ovulate.
 3. Leaflets 8-14.5 cm broad, lower surface uniformly crisped puberulous with pale hairs 7. *G. crispa*
 3. Leaflets narrower, lower surface glabrous or with sparse indumentum confined to the midrib and veins.
 4. Capsule more than 3.5 cm long.
 5. Leaflets 15-35 cm long, secondary veins 12-17 pairs, petals 11.5-14 mm long, capsule 5-6.2 cm long 6. *G. cinnamonea*
 5. Leaflets 10-18 cm long, secondary veins 7-11 pairs, petals 5-7.5 mm long, capsule 3.5-4.5 cm long 1. *G. convergens*
 4. Capsule usually 1.5-2.5 cm long, never more than 3 cm.
 6. Capsule smooth.
 7. Capsule glabrous, shining, brown, with pale lenticels 2. *G. guidonia*
 7. Capsule puberulous or pubescent, not shining, reddish or purple, without lenticels
 8. Leaf rhachis often winged, inflorescence a slender pubescent, raceme or thyse, calyx 1.5-3.5 mm long, staminal tube usually pubescent, capsule often depressed-globose 3. *G. pubescens*
 8. Leaf rhachis never winged, inflorescence pyramidal, lax-branched and lax-flowered, glabrous, calyx 1-1.5 mm long, staminal tube glabrous, capsule ellipsoid, never depressed-globose 4. *G. scabra*
 6. Capsule ribbed or tuberculate.
 9. Leaves 35-75 cm long, capsule globose to ovoid, contracted at the base into a stipe ca. 0.5 cm long 5. *G. humaitensis*
 9. Leaves 9-30 cm long, capsule often depressed-globose, without a stipe, leaves 9-30 cm long 3. *G. pubescens*
 2. Ovary 4-6-locular, loculi with 2 superposed ovules.
 10. Leaflet lamina crisped puberulous below, secondary veins 10-15 pairs, flowers subtended by a bracteole 4-6 mm long, capsule smooth, shortly velutinous 9. *G. trunciflora*
 10. Leaflets coarsely pubescent below, indumentum confined to midrib and veins, secondary veins 16-20 pairs, flowers not subtended by bracteoles 4-6 mm long, capsule longitudinally ribbed 10. *G. carinata*

2.1 *Guarea convergens* T.D. Penn., Fl. Neotrop. 28: 260, fig. 53. 1981. **Fig. 11 a-c**

Young shoots appressed pubescent at first, soon glabrous, becoming cracked and shallowly fissured. Leaves pinnate with a terminal bud showing intermittent growth, up to 50 cm long, petiole semiterete, rhachis terete or channelled above, subglabrous. Leaflets 3-12 pairs (the lower pairs falling), opposite, 10-18 x 4-6 cm, mostly

elliptic, apex shortly and narrowly attenuate, base acute to narrowly attenuate, glabrous, not glandular-punctate or -striate; venation eucamptodromous, midrib sunken on the upper surface, secondaries 7-11 pairs, arcuate, convergent, intersecondaries short to moderate, tertiaries oblique to reticulate. Petiolule 2-5 mm long, sparsely pubescent. Inflorescence axillary, 5-10 cm long, a slender pyramidal thyse,

puberulous. Pedicel 0.5–1.5 mm long. Calyx patelliform or cyathiform, 1–1.5 mm long, irregularly 3–4-lobed, sparsely appressed puberulous outside. Petals 4, 5–7.5 mm long, valvate, appressed puberulous outside, glabrous inside. Staminal tube cylindrical, 4–5.5 mm long, margin undulate, sparsely pubescent outside; anthers 7–8, 0.6–0.8 mm long, glabrous. Nectary stipitate, expanded into a collar below the ovary, glabrous. Ovary 4-locular, loculi 1-ovulate, strigose. **Capsule** 3.5–4.5 cm long, obovoid or globose, apex truncate, base slightly tapered, valves obscurely 6–7-ribbed, smooth or slightly verrucose, mostly puberulous or papillose, valves 4, 1-seeded. **Seed** 1.5–2 cm long.

Field characters: Tree to 25 m high with cylindrical bole, unbuttressed. Bark brown or reddish brown, scaling and fissured, slash reddish. Flowers with pinkish-purple calyx and cream-coloured corolla. Fruit maturing reddish, with a leathery-fleshy pericarp, containing a small amount of white exudate. Flowering in central Amazonia March to December, fruit known from July and August.

Known only from central Brazilian Amazonia, where it is a tree of non-flooded rain forest.

12.XII.1996 (fl) *Assunção, P.A. C. L. & Silva, C. F.* 438 (BM G INPA K MBM MG UB UEC US VEN); 17.X.1995 (fr) *Costa, M. A. S. & Assunção, P.A. C. L.* 384 (BMGINPAKMBMGRUUB VEN); 28.III.1957 (fl) *Coêlho, L.* INPA 5214 (INPA); 7.IX.1994 (fl) *Nascimento, J. R. et al.* 590 (GH IAN ICN INPA K PS UPCB VIC); 13.IX.1995 (fr) *Ribeiro, J. E. L. S. & Pereira, E. C.* 1698 (INPA K MGMONYRBSPUS); 16.V.1963 (fl) *Rodrigues, W. & Coêlho, D.* 5226 (INPA); 4.VI.1995 (fl) *Sothers, C. A. et al.* 482 (INPA K MGMONYRRB SPU); 13.XII.1996 (fl) *Sothers, C. A. & Pereira, E. C.* 956 (B COL F IAN INPA K PUEFR SPF UFMT); 23.VII.1968 (fr) *Souza, J. A.* 50 (INPA).

The floral morphology of *G. convergens* is similar to that of *G. guidonia*, both sharing a 4-locular ovary with 1-ovulate loculi. However, the fruit is quite distinct, being red in colour, 3.5–4.5 cm long, papillose or puberulous, with the valves obscurely ribbed. The capsule of *G. guidonia* is shining brown with prominent pale lenticels, 1.5–2.5 cm long, glabrous and smooth.

2.2 *Guarea guidonia* (L.) Sleumer, Taxon 5(8): 194. 1956; Pennington & Styles, Fl. Neotrop. 28: 261, fig. 53. 1981. Fig. 11 d

Samyda guidonia L., Sp. Pl. 443. 1753.

Guarea trichilioides L., Mant. 2: 228. 1771.

Young shoots puberulous at first, soon glabrous, dark brown with conspicuous pale lenticels. **Leaves** pinnate, with a terminal bud showing intermittent growth, up to 35 cm long, petiole semiterete, rachis semiterete or channelled above, glabrous. Leaflets up to 9 pairs, opposite, 12–25 × 4–7 cm, elliptic, oblong or oblanceolate, apex narrowly attenuate, base acute to narrowly attenuate, glabrous, obscurely glandular-punctate and -striate; venation eucamptodromous, midrib slightly sunken on the upper surface, secondaries 9–12 pairs, steeply arcuate, parallel or slightly convergent, intersecondaries short, tertiaries oblique. Petiolule, 1–5 mm long. **Inflorescence** usually axillary, 10–25 cm long, a slender pyramidal thyse, sparsely pubescent. Pedicel ca. 1 mm long, or flowers sessile. **Flowers** unisexual (plant dioecious). Calyx from rotate to cyathiform, 1–2.5 mm long, 3–4-lobed, sparsely appressed puberulous outside. Petals 4, 5.5–7.5 mm long, valvate, appressed puberulous outside, glabrous inside. Staminal tube cylindrical, 3.5–7 mm long, margin truncate or undulate, glabrous, anthers 8, 0.75–1.25 mm long, glabrous, antherodes of female flower narrow, without pollen. Nectary stipitate, expanded into a collar below the ovary, glabrous. Ovary 4-locular, loculi 1-ovulate, pubescent. **Capsule** 1.5–2.5 cm long, globose to obovoid, apex truncate, base usually contracted into a short stipe, smooth, shining, glabrous, usually with conspicuous pale lenticels, 4-valved, valves 1-seeded, leathery. **Seed** 1–1.5 cm long.

Field characters. Tree to 25 m high, often flowering when much smaller, and in open situations it may be much-branched from near the base. Bark smooth, brown and lenticellate in young specimens, becoming fissured with age. The flowers are cream-coloured and the fruit matures smooth, shining, brown or reddish-brown with conspicuous pale lenticels. *Guarea guidonia* flowers and fruits throughout the year.

Greater Antilles, and from Nicaragua southwards throughout the whole of tropical South America to coastal Brazil, Paraguay and Argentina. It is typically found along riverbanks and in periodically flooded forest, but in the wetter areas of western Amazonia it occurs in high forest on non-flooded sites.

Not recorded from Reserva Ducke.

AMAZONAS: Manaus, Ilha do Careiro, *Prance & Ramos 23300* (FHO).

The most widespread and common species of *Guarea*, easily recognized by the cream-coloured (not pink) flower with 4 petals, 8 stamens, 4-locular ovary with 1 ovary in each locule, and the characteristic shining brown fruit with pale lenticels.

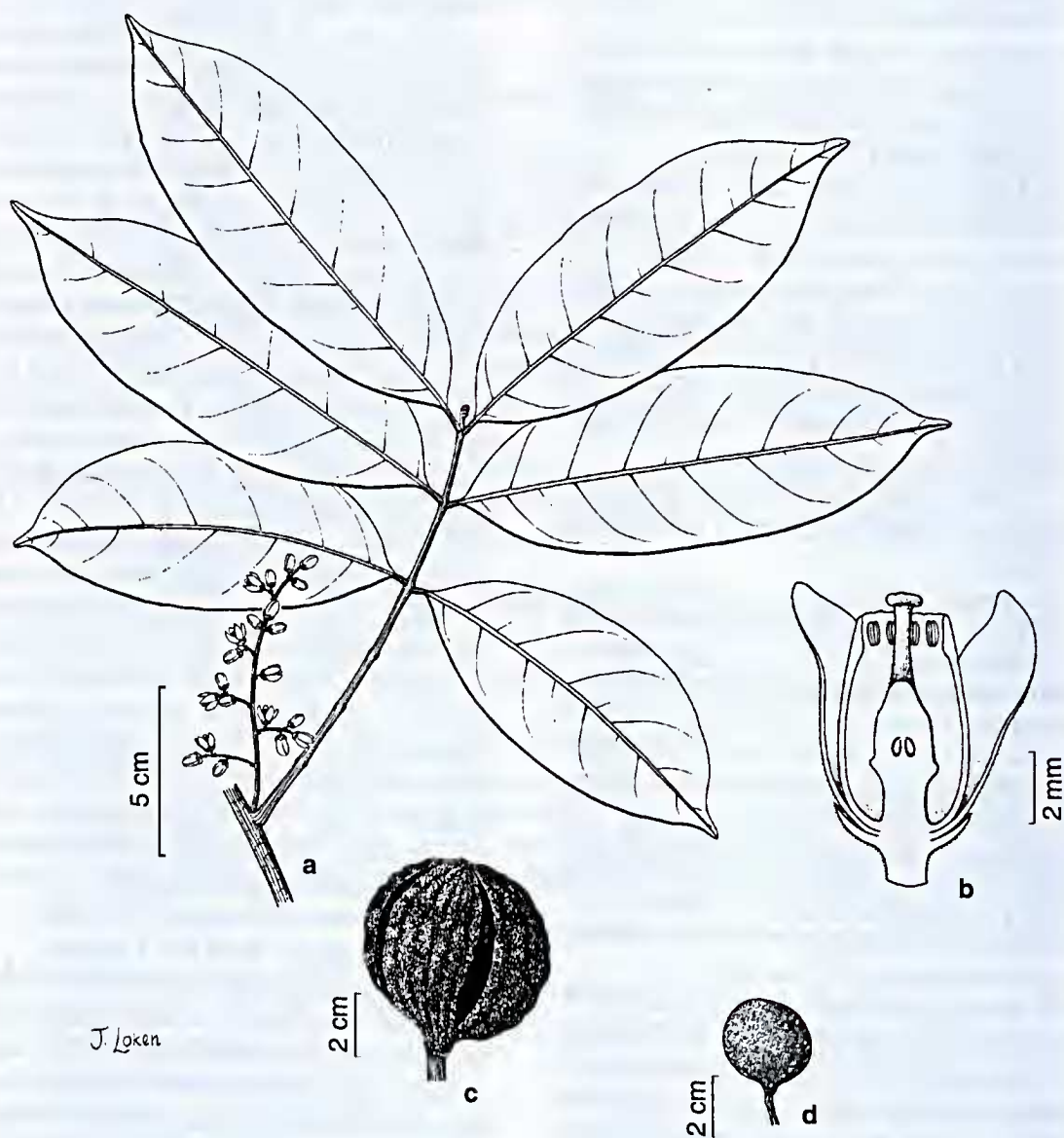


Figure 11 - a-c. *Guarea convergens* - a. habit; b. flower (Pennington et al. 19967); c. fruit (Pennington et al. 19917). d. *G. guidonia* - fruit (Williams 19975).

2.3 *Guarea pubescens* (Rich.) A. Juss., Mém. Mus. Hist. Nat. 19: 241, 286. 1831; Pennington & Styles, Fl. Neotrop. 28: 293, fig. 59. 1981.

Trichilia pubescens Rich., Actes Soc. Hist. Nat. Paris 1: 108. 1792.

Young shoots pubescent at first, becoming glabrous, greyish-white, sometimes thickened and suberous. Leaves pinnate with a terminal bud showing intermittent growth, to 30 cm long, petiole and rachis semiterete or narrowly winged, often channelled above, pubescent at first, becoming glabrous. Leaflets 2–7 pairs, opposite, 9–30 × 3–10 cm, elliptic, oblong or oblanceolate, apex narrowly attenuate, base acute to narrowly attenuate, pubescent or glabrous, sometimes glandular-punctate or -striate; venation eucamptodromous, midrib flat or slightly raised on the upper surface, secondary veins 8–14 pairs, straight or arcuate, parallel or slightly convergent, intersecondaries

short or absent, tertiaries oblique. Petiolule 1–5 mm long. Inflorescence axillary, ramiflorous or cauliflorous, 2–15 cm long, a slender raceme or thyse, pubescent to glabrous. Pedicel 1–2.5 mm long. Calyx patelliform or cyathiform, 1.5–3.5 mm long, irregularly 3–5-lobed, sparsely appressed puberulous outside, glabrous inside. Petals 4, 7–9 mm long, appressed puberulous outside, glabrous inside. Staminal tube cylindrical, 5–7 mm long, margin undulate, glabrous; anthers 8, 0.75–1 mm long, glabrous. Nectary stipitate, expanded into a collar below the ovary, glabrous. Ovary 4-locular, loculi 1-ovulate, densely strigose. Capsule 1.2–2 cm long, depressed globose or globose, base tapered or truncate, valves 4, obscurely 3-ribbed and often minutely tuberculate between the ribs, puberulous or pubescent; valves 1-seeded. Seed 0.8–1.5 cm long, shaped like the segment of an orange.

Key to the subspecies of *Guarea pubescens*

1. Leaflets usually broadly elliptic or oblanceolate, midrib flat or sunken on the upper surface, upper lamina with minute raised dots, petiole and rachis unwinged, capsule often globose and minutely tuberculate; twigs often suberous. *G. pubescens* subsp. *pubescens*
1. Leaflets usually narrowly elliptic or lanceolate, midrib raised on the upper surface, upper lamina without raised dots, petiole and rachis narrowly winged, capsule depressed globose, irregularly ribbed, twigs not suberous. *G. pubescens* subsp. *pubiflora*

2.3a *Guarea pubescens* (Rich.) A. Juss. subsp. *pubescens*; Pennington & Styles, Fl. Neotrop. 28: 295, fig. 59. 1981.

Fig. 12 d-m

Field characters. A small treelet with beige fissured bark, often unbranched. The twigs often develop strongly suberized bark. Flowers with pinkish calyx and greenish-white corolla. Fruit maturing dull red or purple. Flowering in December, fruit in March and June.

From the Guianas & Amapá across Amazonia to Peru, Ecuador and Colombia, where it occurs in lowland rain forest on non-flooded land.

13.XII.1995 (fl) Brito, J. M. et al. 17(K); 19.VI.1965 (fr) Loureiro, A. & Coelho, D. INPA 15521 (INPA); 10.XI.1987 (bd) Nelson, B. W. INPA 191145 (INPA K MG NY SP); 21.III.1995 (fr) Sothers, C. A. et al. 351 (INPA); 9.VIII.1995 (fl) Sothers, C. A. et al. 551 (INPA K MG MO NY RB SP U UB).

2.3b *Guarea pubescens* subsp. *pubiflora* (A. Juss.) T.D. Penn., Pennington & Styles, Fl. Neotrop. 28: 298, fig. 59. 1981.

Fig. 12 a-c
Guarea pubiflora A. Juss., Mém. Mus. Hist. Nat. 19: 241, 287. 1831.

Field characters: A small treelet to 10 m high, often with adventitious aerial roots when subject to flooding. Flowers with reddish-purple calyx and often with pink corolla. The mature fruit has a fleshy reddish-purple pericarp, with seeds surrounded by an orange sarcotesta.

Central Brazilian Amazonia to southern Venezuela, where it is found along riverbanks in periodically and permanently flooded forest.

Not recorded from Reserva Ducke.

AMAZONAS: R. Negro, Cuiciras, Pires et al. 37324 (FHO, INPA); R. Manacapuru, Rodrigues 423 (FHO INPA); mouth of R. Negro, Spruce 1686 (BM G GH GOET K M NY OXF P).

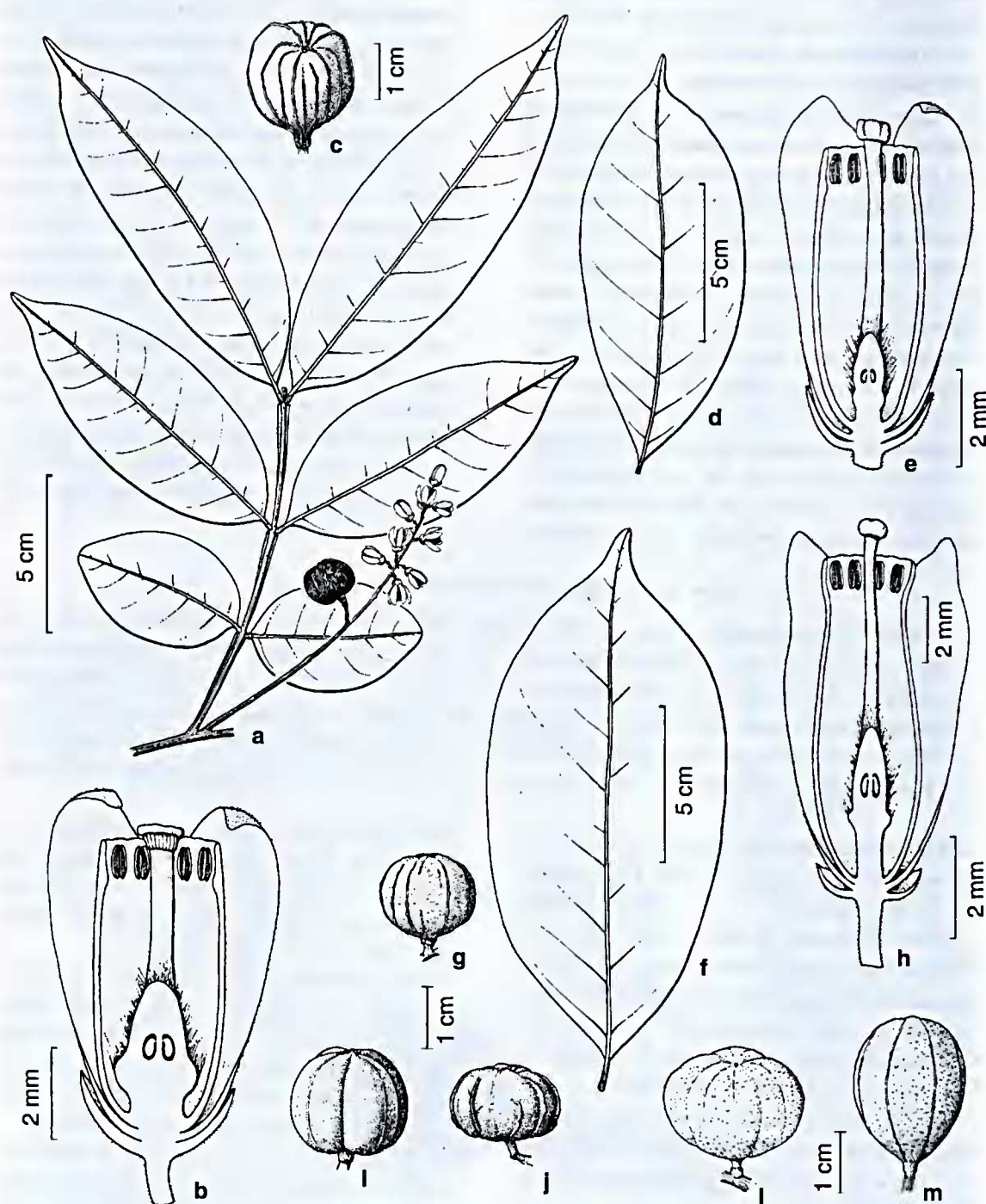


Figure 12 - a-c. *Guarea pubescens* subsp. *pubiflora* - a. habit (Schultes & Lopez 8917); b. flower (Spruce 1909); c. fruit (Pennington et al. 9981). d-m. *Guarea pubescens* subsp. *pubescens* - d. leaflet; e. flower (Gleason 443); f. leaflet; g. fruit (Prance et al. 4203); h. flower (Huber 4622); i-m. fruits (left to right: Sastre 1498, Rodrigues 773, Berlin 413, Mori et al. 8173)

Guarea pubescens is close to *G. guidonia* but can be distinguished from it by the closely parallel oblique tertiary venation, densely strigose ovary and the structure and indumentum of the capsule.

2.4 *Guarea scabra* A. Juss., Mém. Mus. Hist. Nat. 19: 241, 285. 1831; Pennington & Styles, Fl. Neotrop. 28: 304. 1981.

Young shoots minutely appressed puberulous at first, soon glabrous, slightly suberous. Leaves pinnate with a terminal bud showing intermittent growth, to 35 cm long, petiole and rachis semiterete, subglabrous. Leaflets 3–6 pairs, opposite, 9–15 × 3–5 cm, elliptic, apex narrowly attenuate or acuminate, base narrowly cuneate or attenuate, glabrous, not glandular-punctate or -striate; venation eucamptodromous, midrib sunken on the upper surface, secondaries 9–12 pairs, arcuate and convergent, intersecondaries absent, tertiaries oblique, obscure. Petiolule 3–5 mm long. **Inflorescence** axillary and on smaller branches, 5–12 cm long. Calyx patelliform, 1–1.5 mm long, irregularly 4-lobed, subglabrous. Petals 4, 6–9 mm long, valvate, finely appressed puberulous outside, glabrous inside. Staminal tube cylindrical, 5–8 mm long, margin undulate, glabrous; anthers 8, 0.75–1.25 mm long, glabrous. Neetary stipitate, expanded to form a collar below the ovary, glabrous. Ovary 4-locular, loculi 1-ovulate, strigose. **Capsule** ca. 1.5 cm long, ellipsoid to subglobose, valves 4, smooth, pubescent, valves 1-seeded.

Field characters: Tree to 15 m high and 15 cm diameter; the bole sometimes fluted at the base. Bark mid-brown, scaling in rather long plates. Flowers with reddish calyx, and cream-coloured corolla and staminal tube. Flowering in central Amazonia in July and October, fruit in August.

From Amapá and the Guianas across Amazonia to the Brazil Peru frontier, in lowland mixed forest on non-flooded land.

16.VIII.1995 (fr) Costa, M. A. S. et al. 346 (INPA K MG MONY RRB SP U); 31.VII.1997 (fl) Ribeiro, J. E. L. S. et al. 1901 (G INPA K MG MONY RRB SP U); 1.X.1968 (fl) Souza, J. A. 200 (INPA).

Guarea scabra could be confused with *G. convergens* in the vegetative state, except that its leaves tend to dry a dark brown colour. Otherwise the inflorescence and fruit provide distinguishing features. The inflorescence of *G. scabra* is subglabrous, widely branched and lax-flowered, while that of *G. convergens* has obvious indumentum and is more slender and densely-flowered. The fruit of *G. scabra* is smaller than that of *G. convergens*.

2.5 *Guarea humaitensis* T. D. Penn., Fl. Neotrop. 28: 306, fig. 62. 1981. **Fig. 13 a-c**

Young shoots stout, puberulous at first, becoming glabrous. Leaves pinnate with a dormant terminal bud, 35–75 cm long, petiole semiterete, rachis terete, puberulous at first, becoming glabrous. Leaflets 5–7 pairs, opposite, 20–28 × 6–9 cm, oblong, elliptic or oblanceolate, apex acute to acuminate, base usually acute to narrowly cuneate, slightly coriaceous, glabrous above, puberulous on the veins below, or glabrous; not glandular-striate or -punctate; venation eucamptodromous, midrib impressed on the upper surface, secondaries 11–16 pairs, rather steeply ascending, straight, parallel, intersecondaries absent, tertiaries oblique, parallel. Petiolule 3–10 mm long. **Inflorescence** axillary or in the axils of fallen leaves, 10–30 cm long, a rather slender and lax-flowered thyse, puberulous. Pedicel 0.5–1 mm long. **Flowers** unisexual (plant dioecious). Calyx cyathiform, 2–3 mm long, irregularly 3–4-lobed, appressed puberulous outside, glabrous inside. Staminal tube cylindrical, 8–11 mm long, margin undulate, glabrous; anthers 8–9, 1.3–1.6 mm long, glabrous; antherodes in female flower shrunk, without pollen. Neetary stipitate, expanded into a collar beneath the ovary, glabrous. Ovary 4(–5)-locular, loculi 1-ovulate, densely strigose. **Capsule** 1.8–3 cm long, globose to ovoid, contracted at the base into a stipe ca. 0.5 cm long, valves 4(–5), with 3–5 narrow longitudinal wrinkled ribs, puberulous; valves 1-seeded. **Seed** ca. 1 cm long, surrounded by an orange sarcotesta.

Field characters: A little branched tree to 20 m high. Bole cylindrical, bark shallowly

fissured and scaling in irregular pieces, mid-brown. The leaves have a dormant, non-active terminal bud, with all the leaflets unfolding in a single period of growth (cf. *G. cinnamomea*). The flowers are fragrant, with reddish calyx and cream-coloured corolla and staminal tube. The mature capsule is red, with a thin leathery-fleshy pericarp. Flowering from September to January, and fruit maturing January to March.

At present known only from central Brazilian Amazonia where it occurs in non-flooded mixed rain forest.

Local name: Jit6.

11.XII.1993 (fl) *Assunção, P. A. C. L. & Vicentini, A. I.* (INPA K MG NY SP); 6.III.1998 (fr) *Assunção, P. A. C. L. et al.* 809 (IAN INPA K MO NY RB SP); 27.XII.1963 (fl) *Rodrigues, W. & Coêlho, D.* 5620 (INPA); 11.III.1966 (fr) *Rodrigues, W. & Coêlho, D.* 7560 (INPA); 6.X.1994 (bd) *Sothers, C. A.* 213 (INPA K); 31.X.1995 (fl) *Sothers, C. A. & Silva, C. F.* 659 (G INPA K MBM MG MOR RB U).

This species has a similar floral structure as *G. convergens* and *G. guidonia*, but the flowers are larger, and the leaves much longer and with larger leaflets. The stipate capsule with small wrinkled ribs on the valves is also distinctive. It is also close in leaf and floral morphology to *G. cinnamomea*. See there for further comment.

2.6 *Guarea cinnamomea* Harms, Notizbl. Bot. Gart. Berlin-Dahlem 13: 504. 1937; Pennington & Styles, Fl. Neotrop. 28: 307, fig. 62. 1981. Fig. 13 d-e

Young shoots stout, puberulous at first, soon glabrous. **Leaves** pinnate, with a terminal bud with intermittent growth, 15–110 cm long, petiole and rhachis semiterete when young, becoming terete, glabrous. Leaflets 2–11 pairs, opposite, 15–35 × 7–11.5 cm, mostly broadly oblong, apex obtusely cuspidate or narrowly attenuate, base broadly cuneate to rounded, coriaceous, glabrous on the upper surface, minutely puberulous on midrib and veins below; not glandular-punctate or -striate; venation eucamptodromous, midrib sunken on the upper

surface, secondaries 12–17 pairs, parallel, straight, intersecondaries absent, tertiaries oblique and parallel. Petiolule 7–10 mm long. **Inflorescence** axillary and in the axils of fallen leaves, 3–12 cm long, thyrsoid or racemose, few-flowered, puberulous. Pedicel 1–1.5 mm long. Calyx cyathiform, 2.5–3 mm long, irregularly 4–5-toothed or margin truncate, minutely puberulous outside. Petals 4–5, 11.5–14 mm long, valvate, densely appressed pubescent outside, glabrous inside. Staminal tube cylindrical, 9–10 mm long, margin undulate, glabrous; anthers 7–9, 1.5–2 mm long, glabrous. Nectary stipitate, expanded into a collar below the ovary, glabrous. Ovary 4–6-locular, loculi 1-ovulate, densely appressed puberulous. **Capsule** 5–6.2 cm long, ovoid or obovoid, tapering gradually into a short stout stipe, valves 4–6, smooth or faintly ribbed, puberulous or papillose; valves 1-seeded. **Seed** 2.3–2.6 cm long, shaped like the segment of an orange.

Field characters: Tree to 20 m high and 25 cm diameter with massive twigs bearing large terminal clusters of leaves often 1 m in length. The bark is brown, soft and rather suberous, scaling in irregular longitudinal pieces. Flowers with cream-coloured corolla and staminal tube, and fruit maturing bright red. The fleshy-leathery pericarp is eaten by birds. Flowering in central Amazonia in May and June, fruit ripening in September.

Central and western Amazonia, extending to Peru, in lowland rain forest on non-flooded land.

11.IV.1957 (fr) *Albuquerque, B. W. P.* INPA 5531 (INPA); 9.V.1957 (fl) *Albuquerque, B. W. P.* INPA 5559 (INPA); 27.VIII.1974 (st) *Pennington, T. D. et al.* 9925 (INPA); 22.IV.1964 (fr) *Rodrigues, W. & Loureiro, A.* 5775 (INPA).

This species can be confused with *G. humaitensis* when sterile or in flower, but it differs in its much larger, smooth capsule, and in the active terminal bud of the leaves (dormant and non-active in *G. humaitensis*). The two species grow side by side in the vicinity of Manaus, but they have different flowering seasons.

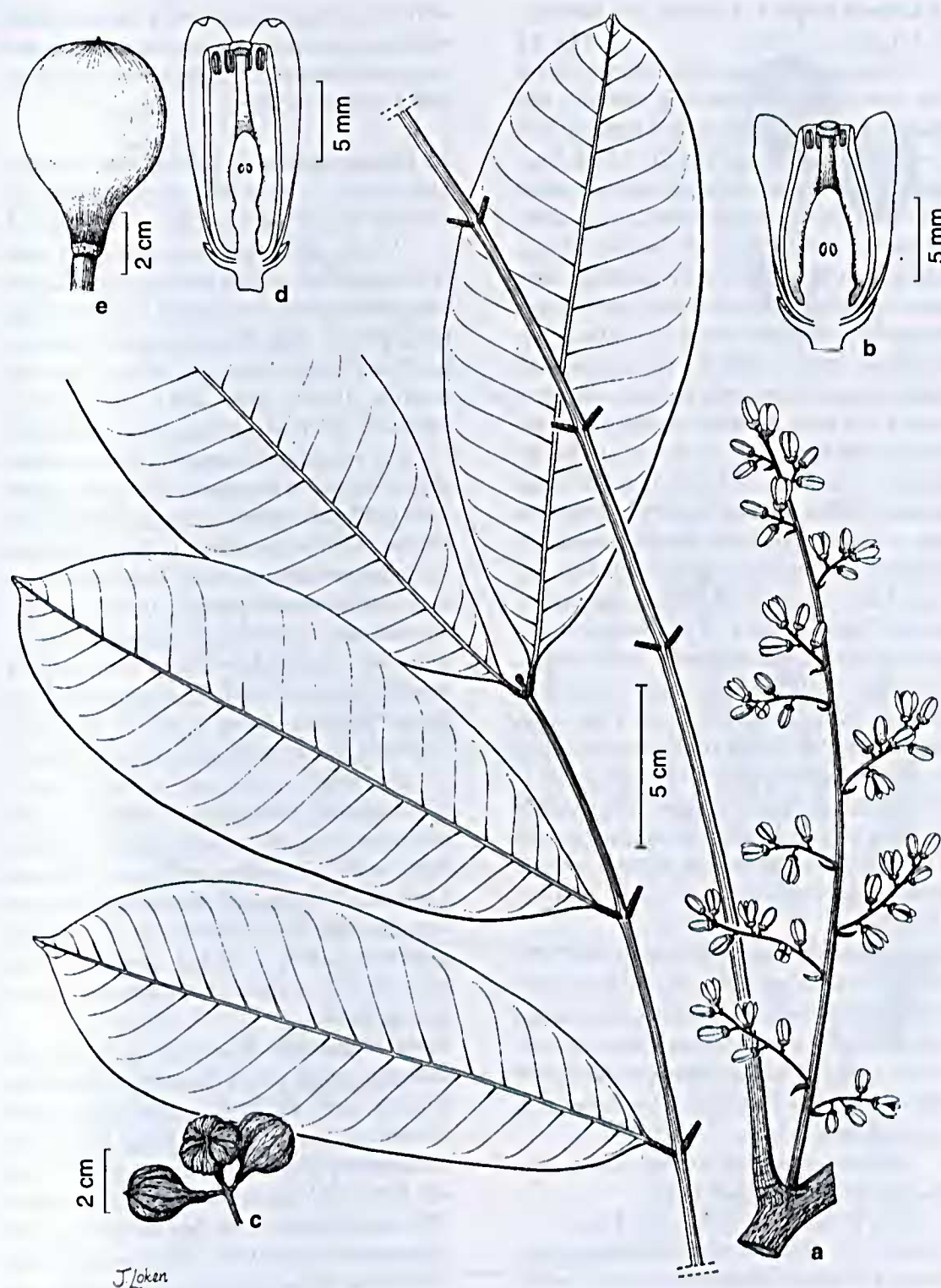


Figure 13 - a-c. *Guarea humaitensis* - a. habit (Pennington et al. 9995); b. flower (Pennington et al. 9989); c. fruit (Rodrigues & Coêlho 16863). d-e. *Guarea cinnamomea* - d. flower (Byron 5559); e. fruit (Pennington et al. 9928).

2.7 *Guarea crispa* T. D. Penn., Fl. Neotrop. 28: 311, fig. 63. 1981. **Fig. 14**

Young shoots stout, crisped puberulous at first, soon glabrous, becoming suberous and fissured. Leaves pinnate with a terminal bud showing intermittent growth, 20–45 cm long, petiole semiterete, rhachis square in section and channelled above, crisped puberulous. Leaflets 3–5 pairs, opposite, 16×8 – 30×14.5 cm, broadly oblong, apex obtuse to shortly cuspidate, base obtuse to truncate, glabrous above, finely crisped puberulous with pale hairs, not glandular-punctate or -striate; venation eucamptodromous, midrib sunken on the upper surface, secondary veins 8–16 pairs, parallel, slightly arcuate, intersecondaries short or absent, tertiaries oblique. Petiolule 2–6 mm long, margins infolded. Inflorescence axillary, 14–26 cm long, a slender pyramidal thyse, puberulous. Pedicel ca. 1.5 mm long. Calyx cyathiform, ca. 3 mm long, obscurely 3–4-lobed, puberulous outside. Petals 4, ca. 12.5 mm long, valvate, sericeous outside, glabrous inside. Staminal tube cylindrical, 9–10 mm long, margin truncate or crenulate, glabrous; anthers 8, ca. 1 mm long, glabrous. Nectary a thick stipe expanded below the ovary, glabrous. Ovary 4-locular, loculi 1-ovulate, densely appressed pubescent. Capsule 2.5–3 cm long, globose, base and apex rounded or truncate, sutures prominent, valves 4, smooth, densely puberulous; valves 1-seeded. Seed ca. 1.5 cm long.

Field characters: Tree to 15 m high and 25 cm diameter with deeply fissured, suberous bark, slash reddish-orange, laminated, and sapwood bright yellow. Flowers with reddish calyx and cream-coloured corolla. Capsule maturing red. Flowering season November to December, fruit maturing April to May.

Known only from central Amazonian Brazil in non-flooded rain forest.

Not recorded from Reserva Ducke.

AMAZONAS: Manaus, Distrito Agropecuário, Reserve 1501 (km 41), Boom *et al.* 8712 (K); Fazenda Porto Alegre, Reserve 3304, Pacheco *et al.* 223 (INPA K).

Guarea crispa is a distinctive and easily recognized species because of its massive twigs

with thick suberized bark, very broad leaflets with close crisped pale indumentum on the lower surface, and the large 4-merous flower with 1-ovulate loculi.

2.8 *Guarea silvatica* C. DC. in Mart., Fl. bras. 11(1): 195, t. 57. 1878. Pennington & Styles, Fl. Neotrop. 28: 323, fig. 67. 1981. **Fig. 15**

Young shoots glabrous, becoming pale brown and often scaling in thin pieces. Leaves paripinnate, without a terminal bud, 15–30 cm long, petiole and rhachis terete, glabrous. Leaflets 3–5 pairs, opposite, 9 – 33×3 – 13 cm, usually elliptic, apex and base narrowly attenuate, glabrous, not glandular-punctate or -striate; venation eucamptodromous, midrib slightly raised on the upper surface, secondary veins 6–10 pairs, slightly arcuate and convergent; intersecondaries moderate to long, tertiaries forming a prominent reticulum. Petiolule 3–5 mm long. Inflorescence axillary, 10–120 cm long, unbranched, with distant cymose fascicles, glabrous. Pedicel 2–5 mm long. Calyx patelliform, ca. 1 mm long, margin obscurely lobed, glabrous. Petals 4, 5–7.5 mm long, imbricate, glabrous. Staminal tube cylindrical, margin entire, glabrous; anthers 8, 0.5–0.75 mm long. Nectary a stout stipe, expanded below the ovary, glabrous. Ovary 2–3-locular, loculi with 1–2 superposed ovules, glabrous. Capsule 3.5–5 cm long, testiculate, constricted between the seeds, 2(–3)-valved, smooth, glabrous; valves 1-seeded. Seed 2.5–3 cm long, ovoid to ellipsoid, bony surrounded by a thin sarcotesta.

Field characters: Tree to 20 m high, often flowering when only a few metres high. Bark smooth, grey-green in young individuals, becoming darker and scaling in narrow rectangular pieces. The creamish-green flowers are borne in long pendulous inflorescences. The capsule has a rather thin leathery, reddish brown pericarp, and the seeds have an orange sarcotesta. Flowering in central Amazonia from August to December with the fruit maturing from March to May.

Found in a broad swathe from the Guianas and Maranhão across Amazonia to the foothills

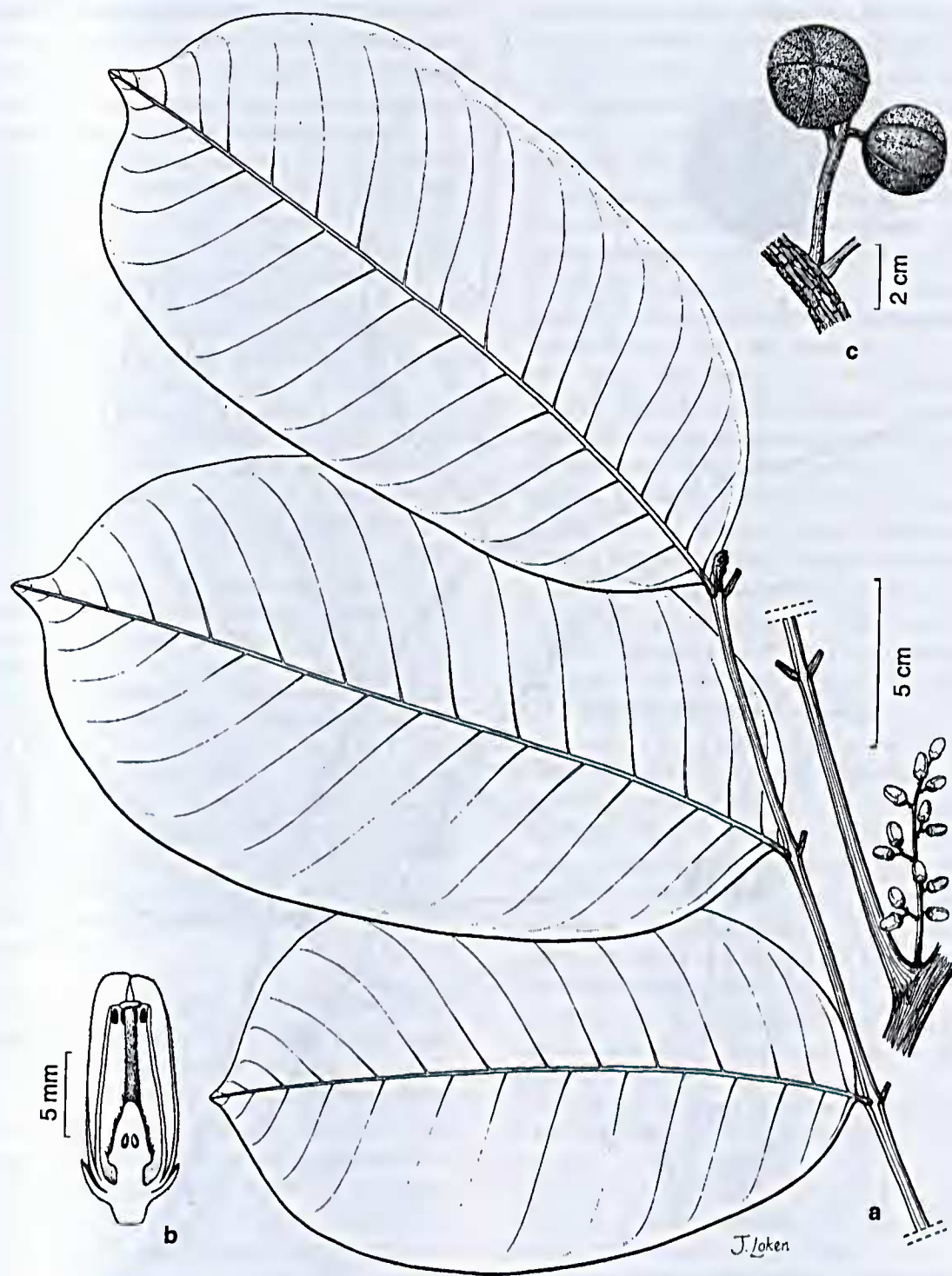


Figure 14 - *Guarea crispa* - a. habit; b. flower (Prance et al. 3061); c. fruit (Rodrigues & Coêlho 2455).

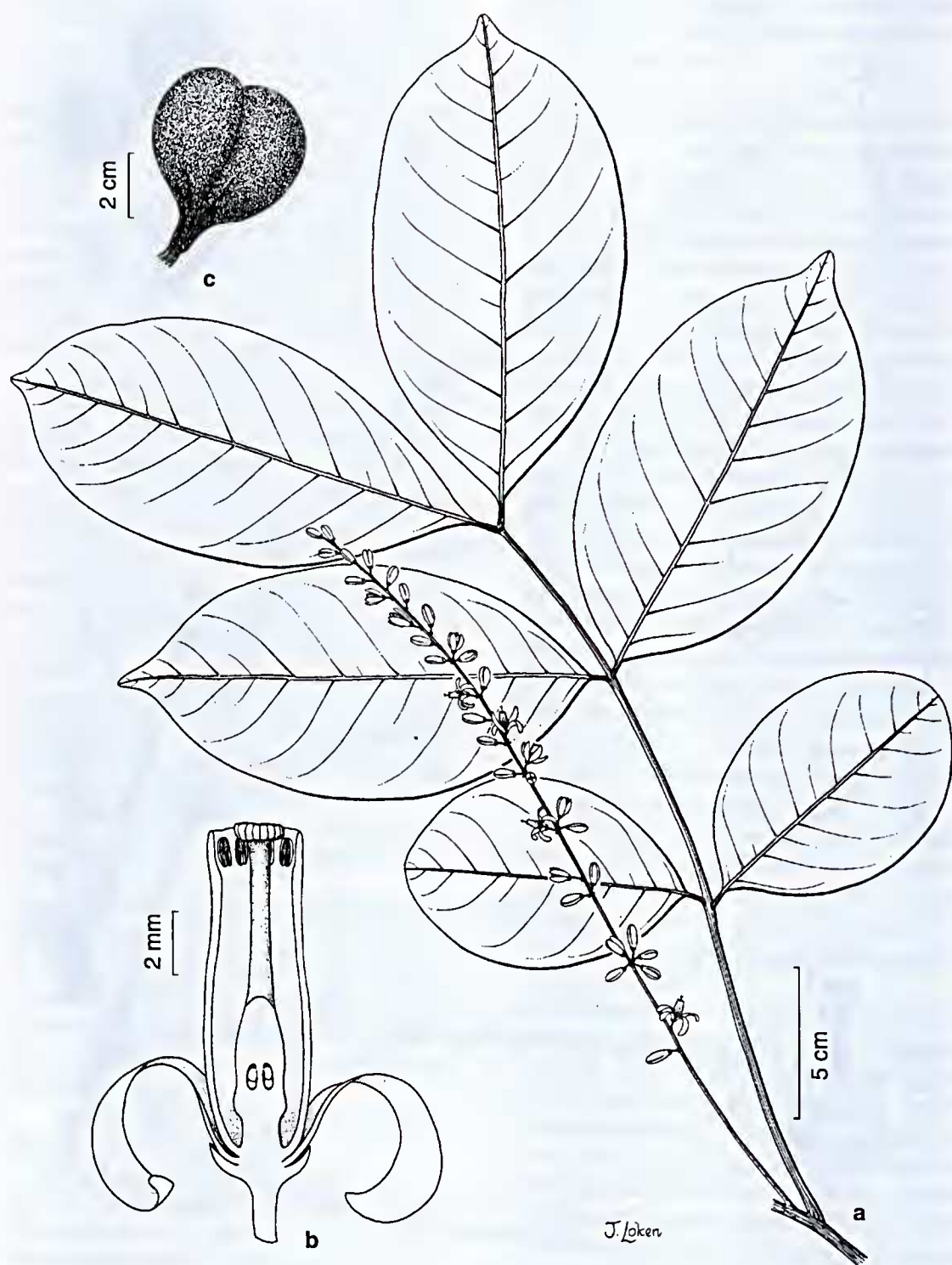


Figure 15 - *Guarea silvatica* - a. habit (Pennington et al. 9900); b. flower (Pennington et al. 9977); c. fruit (Croat 20757).

of the Andes in Peru. A component of the understorey in undisturbed rain forest on non-flooded land, but also present in secondary forest, where it has the ability to withstand repeated coppicing. Coppice shoots are often seen flowering when less than 1 m high.

2.VII.1996 (fl) Assunção, P. A. C. L. et al. 328 (COL FIAN INPA K SPF UEC UFMT VEN); 17.IX.1997 (fl) Costa, M. A. S. & Assunção, P. A. C. L. 779 (INPA K); 25.XI.1997 (fr) Costa, M. A. S. & Silva, C. F. 808 (INPA); 14.X.1965 (fl) Loureiro, A. INPA 16182 (INPA); 5.VI.1993 (fr) Ribeiro, J. E. L. S. et al. 862 (INPA K); 13.VIII.1993 (fl) Ribeiro, J. E. L. S. et al. 1139 (INPA K MG MO NY RB SP U); 14.XII.1994 (fl) Ribeiro, J. E. L. S. & Silva, C. F. 1523 (K); 8.IV.1995 (fr) Ribeiro, J. E. L. S. et al. 1594 (K); 17.XI.1995 (fl) Ribeiro, J. E. L. S. et al. 1763 (BM G INPA K MBM MG R UB US); 26.III.1997 (fr) Ribeiro, J. E. L. S. & Pereira, E. C. 1873 (BM INPA K MBM MG UB UEC US VEN); 6.XI.1961 (fl) Rodrigues, W. & Lima, J. 2735 (INPA); 15.V.1963 (fr) Rodrigues, W. & Coêlho, D. 5216 (INPA); 13.XII.1963 (fl) Rodrigues, W. & Coêlho, D. 5600 (INPA); 15.VII.1964 (fr) Rodrigues, W. & Loureiro, A. 5946 (INPA); 6.X.1964 (fl) Rodrigues, W. & Monteiro, O. P. 6748 (INPA); 1.XII.1967 (fr) Rodrigues, W. & Monteiro, O. P. 8322 (INPA); 1.I.1972 (fl) Silva, M. F. da & Rodrigues, W. 1042 (INPA); 10.V.1995 (fr) Sothers, C. A. & Silva, C. F. 456 (INPA K); 28.XI.1996 (fl) Sothers, C. A. & Silva, C. F. 935 (INPA); 6.VI.1997 (fr) Sothers, C. A. et al. 1015 (INPA); 19.VI.1995 (fr) Souza, M. A. D. & Silva, C. F. 33 (INPA K); 11.III.1994 (fr) Vicentini, A. & Silva, C. F. 424 (INPA K NY).

2.9 *Guarea trunciflora* C. DC., in A. & C. DC., Monogr. Phan. 1: 571. 1878; Pennington & Styles, Fl. Neotrop. 28: 340, fig. 71. 1981.

Young shoots golden-brown tomentose at first, becoming glabrous, suberized and fissured. Leaves pinnate with a terminal bud with intermittent growth, to 70 cm long, petiole, rachis terete, tomentose. Leaflets up to 12 pairs (not more than 5 pairs present at any one time), opposite, 12–21 × 5.5–9.5 cm, broadly oblong or elliptic, apex obtuse or rounded, base acute to rounded, glabrous above, crisped puberulous below, hairs intermixed with minute red papillae (lens);

venation eueamptodromous, midrib sunken on the upper surface, secondaries 10–15 pairs, slightly arcuate, parallel, intersecondaries absent, tertiaries obscure, oblique. Petiolule 3–4 mm long. **Inflorescence** 3–20 cm long, axillary, a lax-branched pyramidal thyrse, densely golden-pubescent, flowers subtended by 1–3 lanceolate bracteoles 4–6 mm long. Pedicel 1–2 mm long. **Flowers** unisexual (plant dioecious). Calyx deeply cyathiform, 7–8 mm long, closed in bud and splitting irregularly to become deeply and irregularly lobed, densely crisped pubescent outside, glabrous inside. Petals 4, 1.1–1.4 cm long, valvate, densely golden-sericeous outside, glabrous inside. Staminal tube cylindrical, 8.5–10 mm long, margin undulate, glabrous; anthers 8–10, 1–1.5 mm long, glabrous; antherodes of female flower narrower, without pollen. Nectary stipitate, expanded below the ovary, glabrous. Ovary 4–5-locular, loculi with 2 superposed ovules, densely strigose. **Capsule** 4 × 3–5.5 × 3.5 cm, broadly ellipsoid or obovoid, apex obtuse or rounded, base acute, valves 4–5, smooth, shortly velutinous; valves with 2 superposed seeds. **Field characters:** Tree to 30 m high and 30 cm diameter, slightly fluted at the base or with small buttresses, bole cylindrical. Bark orange-brown, sealing or fissured and suberous, slash yellowish-cream. Flowers cream-coloured and capsule maturing dark reddish. Flowering in central Amazonas in October and November, and fruit maturing in April and May.

From the Brazil-Guyana frontier, across Amazonia to Peru. A species of non-flooded lowland forest.

29.IV.1995 (fr) Ribeiro, J. E. L. S. et al. 1620 (INPA K MG MONY RB SP); 25.IV.1995 (fr) Sothers, C. A. & Silva, C. F. 411 (G INPA K MG R U UB US); 6.V.1995 (fr) Sothers, C. A. & Pereira, E. C. 426 (BM COL E INPA K MBM MG UEC VEN); 16.X.1968 (fl) Souza, J. A. 221 (INPA).

This species is related to *G. carinata* but differs from it in the much finer crisped indumentum on the lower leaf surface, by the longer calyx which splits irregularly and by the smooth, shortly velutinous capsule.

2.10. *Guarea carinata* Ducke, Trop. Woods 76: 16. 1943; Pennington & Styles, Fl. Neotrop. 28: 342, fig. 72. 1981.

Fig. 16

Young shoots coarsely pubescent to tomentose, soon becoming glabrous, suberous and longitudinally fissured. **Leaves** pinnate with a terminal bud showing intermittent growth, to 60 cm long, petiole semiterete, rhachis terete, tomentose or pubescent at first, becoming glabrous. Leaflets to 10 pairs, opposite, 12–25 × 6–9 cm, usually oblong or elliptic, apex attenuate to obtuse or rounded, base acute to truncate,

upper surface glabrous or with pubescent midrib, lower surface coarsely pubescent on midrib and veins, sparser on the lamina, not glandular-punctate or -striate; venation eucamptodromous or brochidodromous, midrib sunken on the upper surface, secondary veins 16–20 pairs, parallel, slightly arcuate, intersecondaries short, tertiaries oblique. Petiolule 2–6 mm long. **Inflorescence** axillary or in the axils of fallen leaves, 2–10 cm long, a rather densely-flowered slender panicle, tomentose. Pedicel 1–2 mm long. **Flowers** unisexual (plant dioecious). Calyx cyathiform, 3–

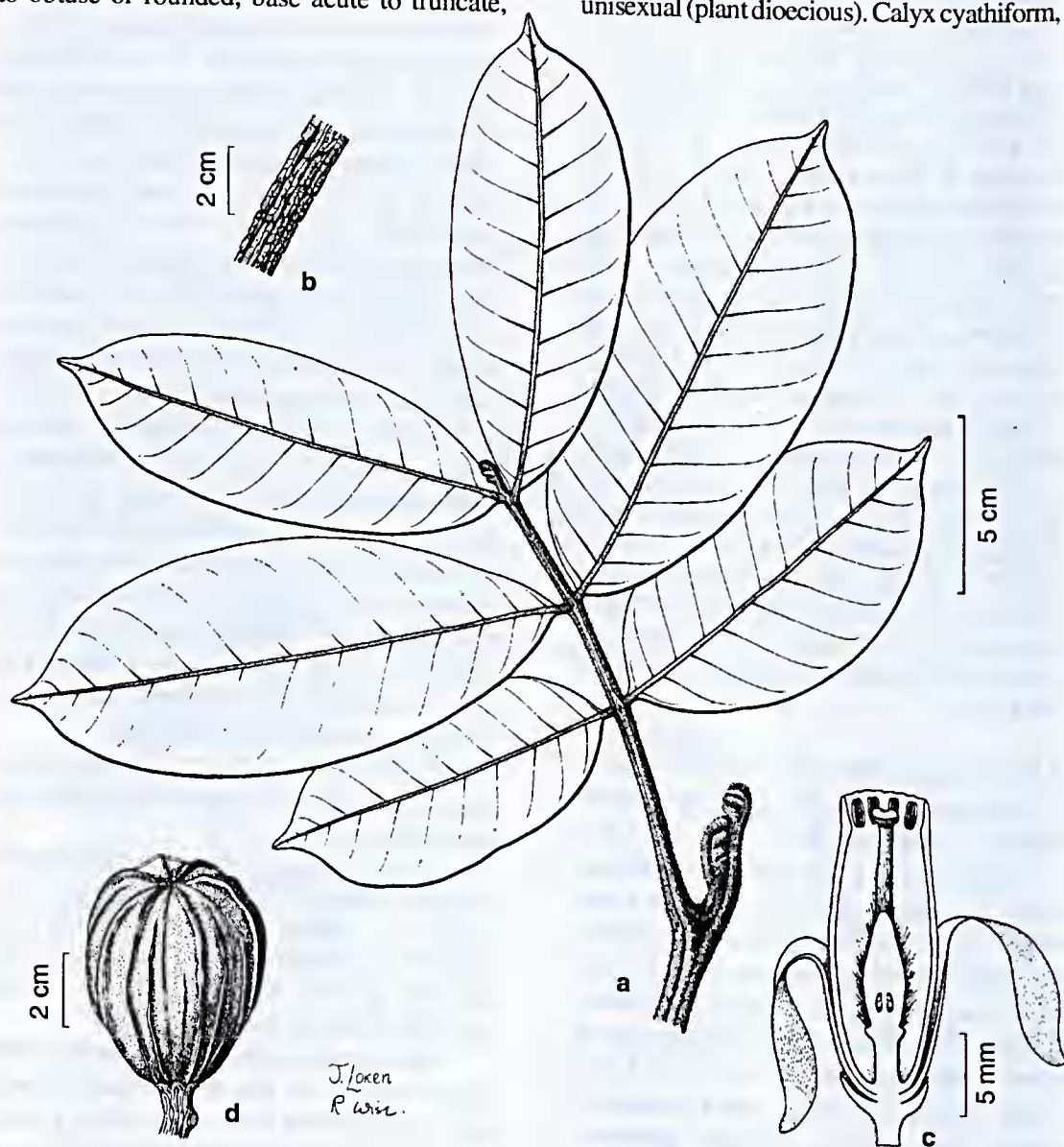


Figure 16 - *Guarea carinata* - a. habit (Pennington et al. 10078); b. young branch with suberized bark (Pennington et al. 9930); c. flower (Prance et al. 2244); d. fruit (Pennington et al. 9975).

7 mm long, shortly 4-lobed, densely pubescent outside. Petals 4, 1.4–1.7 cm long, valvate, densely golden-strigose outside, glabrous inside. Staminal tube cylindrical, 1.1–1.3 cm long, margin undulate, glabrous; anthers 8–11, 1.5–1.8 mm long, glabrous; antherodes of female flower narrower, without pollen. Nectary a stout stipe, expanded to form a collar below the ovary, glabrous. Ovary usually 5–6-locular, loculi with 2 superposed ovules, densely strigose. **Capsule** 3–5 cm long, depressed globose to obovoid, apex truncate, base rounded or tapered, valves usually 5–6, shallowly or prominently 3-ribbed, the central rib often branched and anastomosing with the others, tomentose to pubescent; valves with 2 superposed seeds. **Seed** ca. 1.5 cm long, surrounded by a thin sarcotesta.

Field characters: Tree to 20 m high with soft suberous brown bark, scaling in thin irregular pieces. The twigs and branches also become suberized. Flowers with green or reddish calyx and cream-coloured corolla and staminal tube. The large purplish carinate capsule is very conspicuous in the field. Flowering in central Amazonia from July to September, with the fruit maturing from October to January.

Known from scattered collections extending from Surinam and Pará across Amazonia to the Brazil-Peru frontier. It is confined to undisturbed mixed forest on non-flooded land.

(st) Pennington, T. D. et al. 9922 (FHO INPA K); 9.IX.1966 (fl) Prance, G. T. et al. 2244 (INPA);

15.X.1963 (fr) Rodrigues, W. 5498 (INPA); 3.V.1968 (fl) Souza, J. A. INPA 21218 (INPA).

AMAZONAS: Manaus-Itacoatiara, km 65, Egler Reserve, Pennington et al. 9936 (FHO INPA K); Manaus, CEPLAC Reserve, Pennington et al. 9930 (FHO INPA K).

This species is closest to *G. trunciflora*. See there for further comment. The large carinate purple fruit is most distinctive.

3. *Cedrela*

Cedrela P. Browne, Civil & Nat. Hist. Jamaica 158, tab. 10, fig. 1. 1756. Earle Smith, Fieldiana Bot. 29: 295. 1960.

Trees. Shoot apex bearing a cluster of scale-leaves. Indumentum of simple hairs. **Leaves** usually paripinnate. **Flowers** unisexual (plant monoecious), in large terminal, much branched thyrses. Calyx lobed to near base, cup-shaped, or shallowly toothed. Petals 5, free, imbricate, adnate 1/3 to 1/2 their length to a columnar androgynophore (nectary) by a medium keel. Stamens 5, free but adnate to andro-gynophore below. Ovary 5-locular, borne at the apex of the gynophore, loculi with 8–4 ovules; style-head discoid. **Fruit** a woody septifragal capsule, opening from the apex by 5 valves, with a woody central columella. **Seeds** with a terminal wing, attached by the seed end to the apex of columella and winged towards the base of the capsule.

About 14 species confined to the Neotropics; 2 species in central Amazonia, 1 species recorded from Reserva Ducke.

Key to the species of *Cedrela* in the Manaus area

1. Leaflets 6–12 pairs, lower lamina generally glabrous, terminal cymules of inflorescence open, lax; petals greenish-white, capsule 2–3.5 cm long. 2. *C. odorata*
1. Leaflets 11–18 pairs, lower lamina generally velutinous to villose, terminal cymules of inflorescence crowded and congested, petals with a pinkish tinge outside; capsule 6–10 cm long. 1. *C. fissilis*

3.1 *Cedrela fissilis* Vell., Fl. Flum. 72 text. 1825, tab. 68. 1835; C. DC., in Mart., Fl. bras. 11(1): 223, tab. 65, fig. 2. 1878; Pennington & Styles, Fl. Neotrop. 28: 361, fig. 76. 1981.

Fig. 17 a-d

Young shoots subglabrous, smooth, with pale lenticels. **Leaves** paripinnate, 25–65 cm long, petiole and rhachis terete,

tomentose or pubescent at first, becoming glabrous. Leaflets 11–18 pairs, opposite, lanceolate, asymmetrical, apex narrowly acuminate, base obtuse, rounded or truncate, asymmetrical, usually velutinous or pilose below, venation eucamptodromous, midrib slightly raised on the upper surface, secondary veins 14–17 pairs; slightly arcuate

and convergent, intersecondaries short to moderate, tertiaries reticulate. Petiolule 1–1.5 mm long. **Inflorescence** terminal, 50–80 cm long, widely branched, ultimate cymules usually congested. Pedicel 1–2 mm long. Calyx cyathiform, shallowly lobed, 1.5–2.5 mm long, densely pubescent. Petals 5, 8–10 mm long, free, imbricate, densely tomentose on both surfaces. Stamens 5, filaments 1.5–2.5 mm long, glabrous, anthers 1.5 mm long. Ovary globose, 5-locular, loculi 8–12-ovulate; pistillode in male flower slender, with vestigial ovules. **Capsule** 6–10 cm long, obovoid, pendulous, 5-valved, valves woody, dark brown with dense pale lenticels, glabrous, columella with 5 prominent broad wings. **Seeds** 2.5–4.5 cm long (including wing), dark brown.

Field characters: Tree to 35 m high and 1 m diameter, bark greyish-brown, deeply fissured, with the ridges scaling, slash pink, fibrous. Flowers with greenish petals with pink tinge at the apex. The fruit matures in central Amazonas in April. Most parts of the tree smell of garlic when crushed.

From Costa Rica southwards, throughout tropical South America to coastal Brazil and northern Argentina. It is usually found on well-drained soils in lowland mixed forest up to 800 m altitude.

8.IV.1988 (fr) Santos, J. L. & Lima, R. P. 891 (INPA KMG MONYRB SP U).

Local names & uses: *Cedro*. The timber is similar to but darker than that of *C. odorata*, and lacks the characteristic scent of the latter. It is however often mixed with *C. odorata* and highly valued for joinery due to the ease with which it can be worked, and for plywood veneer.

3.2 *Cedrela odorata* L., Syst. Pl. ed. 10, 940. 1759; Pennington & Styles, Fl. Neotrop. 28: 374, figs. 76, 76A. 1981. **Fig. 17 e-h**

Young shoots usually glabrous, with conspicuous lenticels. **Leaves** paripinnate, 25–60 cm long, petiole semiterete, rhachis terete, puberulous at first. Leaflets 6–12 pairs, usually opposite, ovate, oblong-

lanceolate or lanceolate, apex acute to acuminate, base asymmetrical, acute to rounded, usually glabrous or with sparse indumentum midrib and veins below; venation eucamptodromous, midrib slightly raised on the upper surface, secondary veins 14–15 pairs, slightly arcuate and convergent, intersecondaries short to moderate, tertiaries reticulate. Petiolule 0–2 cm long. **Inflorescence** terminal, 15–40 cm long, a widely branched panicle, cymules lax, puberulous. Pedicel 1–2 mm long. Calyx cyathiform or broadly tubular, 2–3 mm long, puberulous or glabrous. Petals 5, 7–8 mm long, free, imbricate, pubescent on both surfaces. Stamens 5, filaments 2–3 mm long, glabrous, anthers ca. 1.5 mm long. Ovary ovoid, 5-locular, loculi with 10–14 ovules, glabrous; pistillode in male flower slender, with vestigial ovules. **Capsule** 2–3.5 cm long, ellipsoid to obovoid, pendulous, 5-valved, valves thinly woody, grey-brown or brown with prominent pale lenticels, columella with 5 broad wings. **Seeds** 2–3 cm long (including wing), light brown.

Field characters: Deciduous tree to 35 m high and 1.5 m diameter, with small buttresses, bole cylindrical with greyish-brown fissured bark, the ridges scaling. Slash pink, fibrous, bitter. The crushed branches, leaves and fruit often smell strongly of garlic. Flowers scented, with greenish-cream corolla.

Mexico and Central America, Greater and Lesser Antilles and throughout tropical South America to northern Argentina. Predominantly found in dry and moist lowland forest, both deciduous and evergreen. It attains its greatest development in the non-seasonal rain forests of the Andean foothills in Ecuador where it becomes a huge tree. Elsewhere in drier seasonal climates it may only be a small tree with a twisted bole. It is frequently found in secondary vegetation and because of its value for timber it is always protected. Its latitudinal range is from sea level to 1200 m.

Not recorded from Reserva Ducke. AMAZONAS: Manaus to Caracaraí, km 184, Pennington et al. 9965 (FH0).

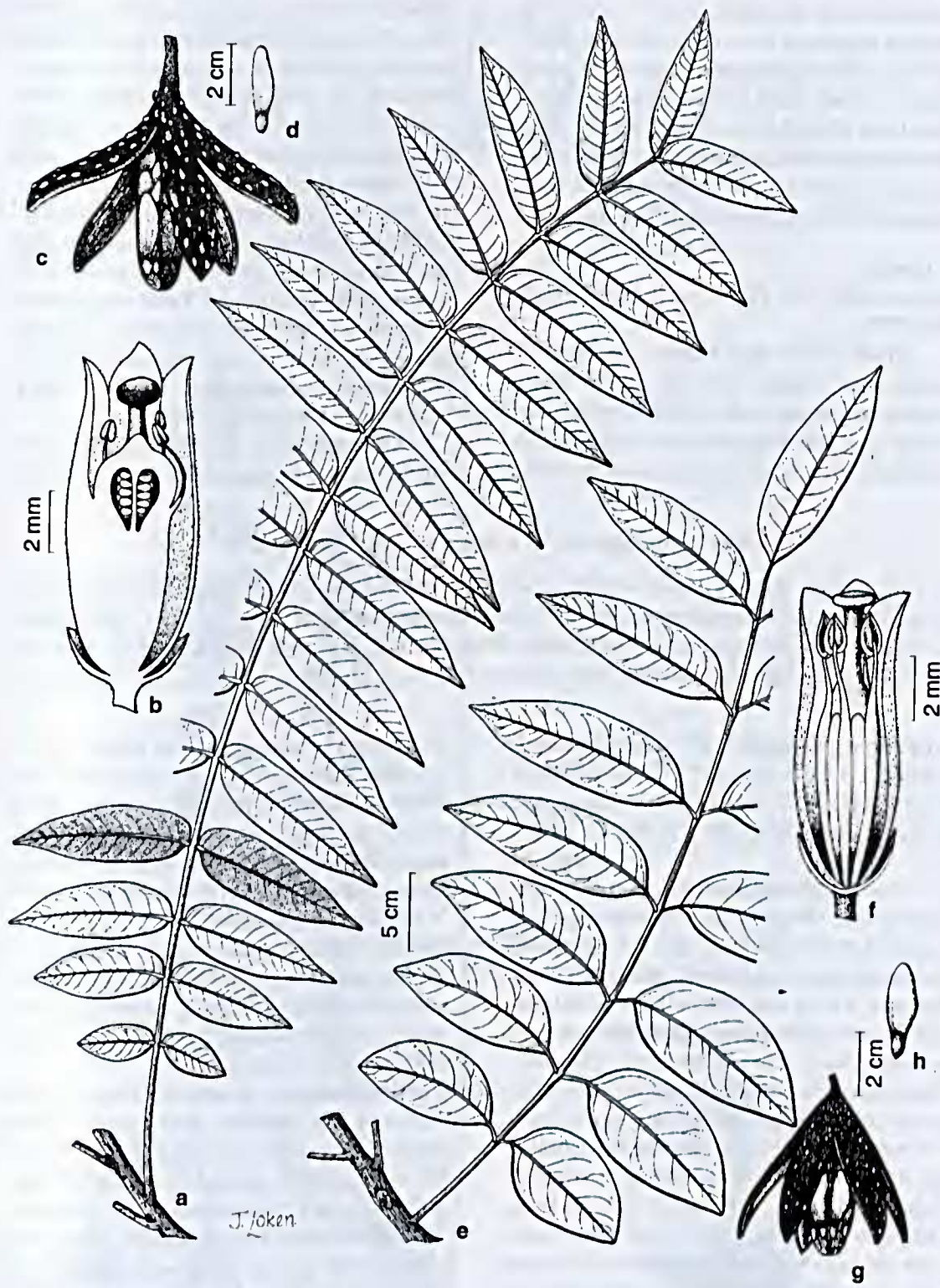


Figure 17 - a-d, *Cedrela fissilis* - a. branchlet; b. female flower (Ramalho 409); c. fruit; d. seed (Reitz 6389). e-h, *Cedrela odorata* - e. branchlet; g. fruit; h. seed (Styles 171); f. male flower (Chaplin 407).

Local names & uses: Cedro. *Cedrela odorata* produces one of the best tropical timbers, known in the trade as Spanish Cedar, which is widely used for veneer and joinery. It has been utilized for several hundred years, but although forest clearance and exploitation have reduced its natural range, it is still very common due to protection and planting.

4. *Carapa*

Carapa Aubl., Hist. Fl. Guiane 2, Suppl.: 32, t. 387. 1775.

Trees. Shoot apex bearing a cluster of scale-leaves. Indumentum of simple hairs. **Leaves** paripinnate with a dormant glandular leaflet at apex. **Flowers** unisexual (plant monoecious), in large erect thyrsoid panicles,

axillary or clustered at apex in axils of sterile bracts. Calyx 4–5-lobed almost to base, lobes imbricate. Petals 4–5, free, usually imbricate, spreading in open flowers. Staminal tube cyathiform, urceolate or cylindrical, margin with entire or lobed appendages alternating with 8–10 anthers fixed within the throat of the tube. Nectary well-developed, cushion-shaped, surrounding the base of the ovary and partially fused to it. Ovary 4–5-locular, loculi 3–8-ovulate, style-head discoid. **Fruit** a pendulous, subwoody, subglobose, septifragal capsule, opening by 4–5 valves from apex and base simultaneously. **Seeds** large, angular, with a thick corky or woody sarcotesta.

Three species in tropical America, one of which (*C. procera*) also occurs in West Africa.

Key to the species of *Carapa* of the Manaus area

1. Bark scaling, flowers usually sessile, predominantly 4-merous with 8 anthers, 4-locular ovary, leaflets usually more or less elliptic with acute to acuminate apex 1. *C. guianensis*
1. Bark smooth, flowers slender-pedicellate, predominantly 5-merous with 10 anthers, 5-locular ovary, leaflets generally oblong with rounded apex 2. *C. procera*

4.1 *Carapa guianensis* Aubl., Hist. Fl. Guiane 2, Suppl.: 32, tab. 387. 1775. C. DC. in Mart., Fl. bras. 11(1): 223, tab. 64. 1878; Pennington & Styles, Fl. Neotrop. 28: 407, fig. 83. 1981.

Fig. 18

Young shoots massive, subglabrous, lenticellate. **Leaves** paripinnate, densely clustered at shoot apex, 50–90 cm long, petiole and rachis terete, glabrous. Leaflets 5–9 pairs, opposite, 18–25 × 6–9 cm, elliptic or oblong-elliptic, apex acute to acuminate, less frequently rounded, base acute to truncate, glabrous; venation mostly eucamptodromous, midrib flat or slightly raised on the upper surface, secondary veins 9–12 pairs, straight, parallel, intersecondaries short to moderate, tertiaries oblique, obscure. Petiolule 1–1.5 cm long. **Inflorescence** clustered around the shoot apex above a cluster of scale-leaves, 30–60 cm long, a lax-branched thyrs, the terminal cymules densely clustered, with scurfy pubescence. Pedicel 0–2 mm long. Calyx 1–2 mm long, 4-lobed to near the base, lobes

rounded, imbricate, glabrous. Petals 4, 4.5–5.5 mm long, glabrous. Staminal tube urceolate, 3.5–4.5 mm long, margin with 8 truncate, rounded or variously lobed appendages, glabrous; anthers 8. Nectary cushion-shaped. Ovary 4-locular, loculi with 2–4 ovules, glabrous; pistillode in male flowers slender, with vestigial ovules. **Capsule** 5–10 cm long, globose or weakly quadrangular, valves 4, woody, obscurely ridged, glabrous, with a rough surface. **Seeds** 4–5 cm long, angular, corky or woody.

Field characters: A buttressed tree to 35 m high and 1 m diameter. Bark brown, scaling irregularly in plates, slash bright pink to red, fibrous, sapwood pinkish to cream. The new foliage opens a characteristic wine-red colour. Flowers scented, with the sepals green below and pinkish above, petals and staminal tube cream-coloured, and nectary orange-yellow. The capsule and ripe seeds are both brown. Flowering in central Amazonia July to October, with the fruit taking up to a year to mature.



Figure 18 - *Carapa guianensis* - a. habit (Prance et al. 1378); b. female flower; c. male flower (Prance et al. 1644); d. fruit (Fróes 1728).

Central America, Greater and Lesser Antilles and the whole of northern South America to western Ecuador and eastern Peru. In central Amazonia it is most frequent on poorly drained and periodically flooded land, but it also extends to terra firme forest. In the Andean countries it is also present in submontane regions between 700 and 1400 m altitude.

8.VII.1994 (fl) Hopkins, M. J. G. *et al.* 1452 (K INPA); 23.XI.1995 (fl) Ribeiro, J. E. L. S. *et al.* 1768 (INPA K MG NY); 7.X.1997 (fl) Souza, M. A. D. *et al.* 425 (G INPA K MG MO NY RB SP U UB); 7.IV.1998 (fl) Souza, M. A. D. *et al.* 665 (INPA); 7.IV.1998 (fl) Souza, M. A. D. *et al.* 688 (INPA).

Local names & uses: Andiroba. The species provides an important timber used for construction but also in high class joinery. It is similar to true mahogany (*Swietenia* spp.) but harder and heavier. The seeds provide a widely used oil for lamps, soap, candle making, insect repellent and recently it has become fashionable as an environmentally friendly skin-care lotion.

This species can be distinguished in the field from *C. procera* by its characteristic bole. Large species have well-developed buttresses (never present in *C. procera*), and a densely scaling bark (bark smooth in *C. procera*).

4.2 *Carapa procera* A. P. de Candolle, Prodr. 1: 626. 1824; C. DC. in A. & C. DC., Monogr. Phan. 1: 564. 1878; Pennington & Styles, Fl. Neotrop. 28: 414, fig. 84. 1981.

Young shoots massive, subglabrous. Leaves paripinnate, densely clustered at the shoot apex, 40–90 cm long, petiole and rachis terete, glabrous. Leaflets 5–8 pairs, opposite, 20–40 × 7–12 cm, usually broadly oblong apex rounded, base rounded or obtuse, glabrous; venation mostly eucamptodromous, midrib flat

or raised on the upper surface, secondary veins 10–18 pairs, straight, parallel, inter-secondaries short to moderate, tertiaries oblique, obscure. Petiolule 2–12 mm long. **Inflorescence** axillary or subterminal in the axils of scale leaves, 30–80 cm long, widely branched, glabrous or scurfy. Pedicel 2–5 mm long. Calyx 1–1.5 mm long, 5-lobed almost to the base, lobes rounded, imbricate, glabrous. Petals 5, 4–8 mm long, glabrous, margin sometimes ciliate. Staminal tube cyathiform or urceolate, 3–4.5 mm long, margin with 10 entire or lobed appendages, glabrous; anthers 10. Nectary cushion-shaped, ribbed, glabrous. Ovary 5-locular, loculi with 3–6 ovules, glabrous; pistillode in male flower slender, with vestigial ovules. **Capsule** 7–9 cm long, ovoid to subglobose, valves 5, woody or leathery, with an obscure median ridge, glabrous, rough, lenticellate. **Seeds** 3–4 cm long, angular, corky or woody.

Field characters: An unbranched pachycaulous treelet to large forest giant 30 m high, unbuttressed, bole cylindrical with smooth pale bark. Flowers scented, with pale cream corolla and staminal tube. Capsule brown, rough-skinned. Flowering in central Amazonia in August.

The Guianas to central Amazonian Brazil (the species also occurs in West Africa). It occurs in high forest and terra firme but also along riverbanks and on poorly drained land.

Not recorded from Reserva Ducke.

AMAZONAS: Manaus-Caracarái km 61, Pennington *et al.* 9931 (FHO INPA).

Uses: This species is also exploited for its timber.

Distinguished from *C. guianensis* in the field by its bole and bark characters (see under *C. procera*) and in the herbarium by the 5-merous flowers with longer pedicels.